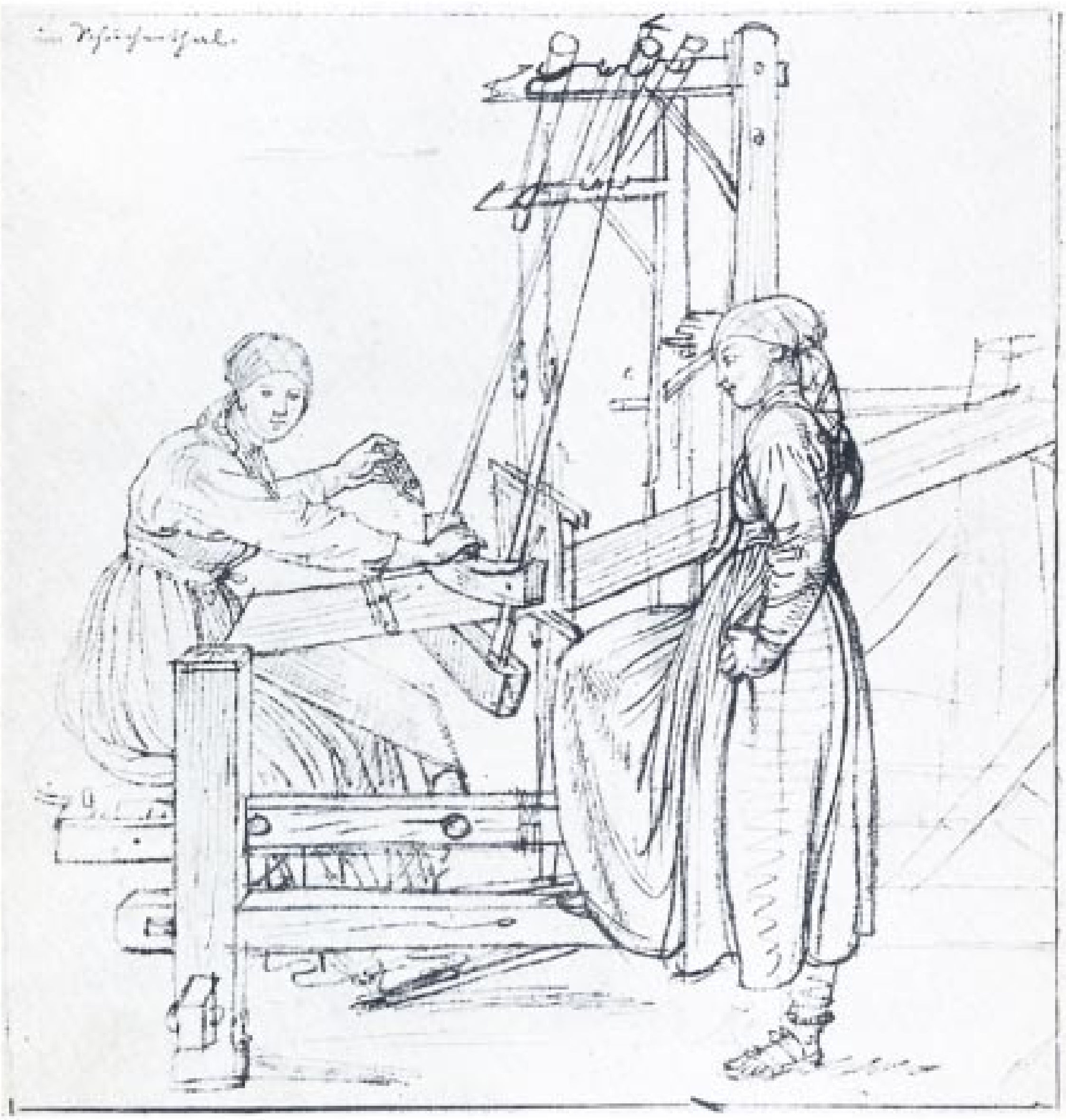
Ciba Review 16



Home weaving in the canton of Uri (Switzerland). Drawing from first half of 19th century by Ludwig Vogel (1788 to 1879). Swiss National Museum, Zurich.

The Loom

Bright

fast to light

substantive

Greens

with

Chlorantine

Fast Green

5 GLL

Ciba Review 16

Basle . December 1938

The Loom

Contents:

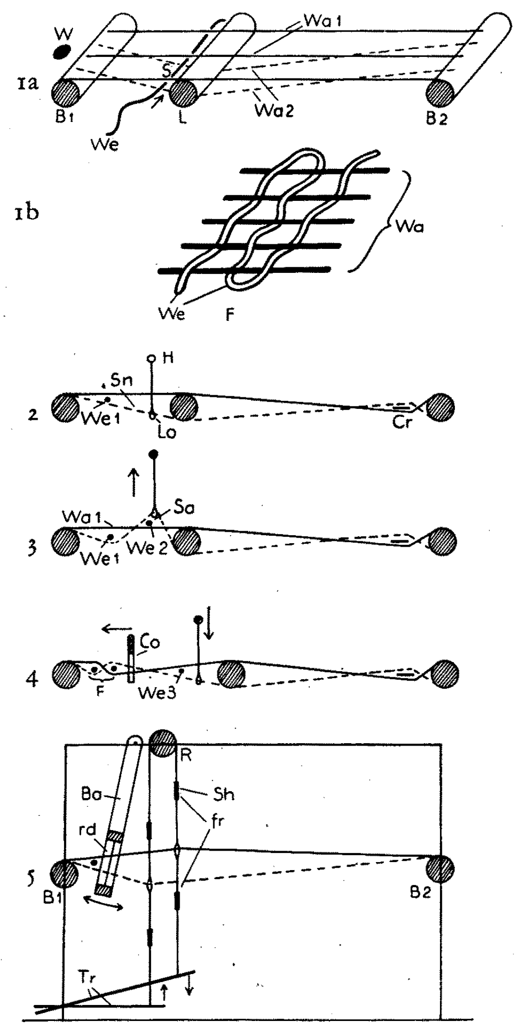
The Principle of the Loom

By G. Schaefer

The term loom comprises every kind of cloth-weaving instrument from the simplest wooden frame to the complicated power-driven apparatus of modern industry. It is used in this sense in the following survey, though the looms and weaving-technique of primitive peoples are not discussed here. It is hoped to do so in some detail in a later number.

The laborious task of transforming thousands of threads into a closely wrought fabric entirely by hand, and only with the help of a primitive frame, must at a very early date have aroused the desire to mechanize the process of weaving, the interlacing at right angles of two systems of parallel threads.

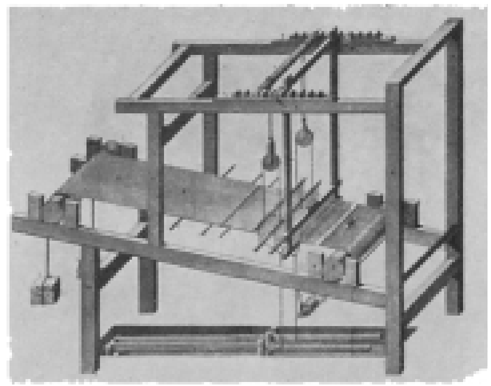
Though the loom of the pre-Christian era may seem crude when compared with its fellow of the machine-age, and though even in the Middle Ages revolving shafts, rollers, etc., do not appear to have been used, nevertheless even the very simplest form of loom required certain technical ability. Every finished fabric is in structure essentially three-dimensional, though it may, by reason of its two most noticeable features, length and breadth, appear to have only these two dimensions. Into a system of longitudinal threads (warp, caine, twist), an unbroken succession of cross-threads (weft, woof, shoot) is laced in such a manner that each weft-thread passes alternately over and under every thread of the warp. In this manner all the warp-threads are firmly secured in a lateral direction. In order to ensure the same firmness in the longitudinal direction, the returning weft-thread is conducted in such a manner as to pass under the warp-thread over which it had previously passed, and vice versa (see ill. fig. 1 b, F = fabric, Wa = warp, We = weft). This fundamental type, which is the foundation of all other fabrics, even the most intricate, is achieved on all looms of all ages and races by the formation of what is called the shed. The type of loom and manner of forming the shed customary among the Ancients, and today among primitive and some Oriental peoples, is shown in figures 1–4. The loom is taken as horizontal, the position of the weaver is marked W (fig. 1). The loom consists of two beams, front-beam (B 1) and rear-beam (B 2) (fig. 1 a). Between the two beams the warp-



Figures 1–5. The process of weaving on hand-frame and loom proper. By G. Schaefer, Basle.

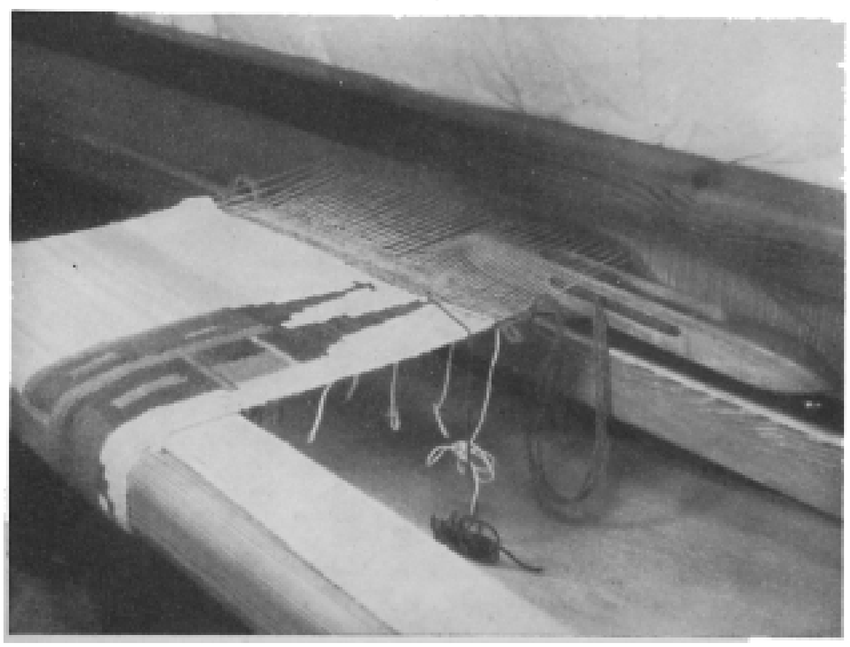
threads (Wa 1 and Wa 2) are stretched. The so-called lease-rod (L), here drawn with large diameter to ensure distinctness, is inserted between the threads of the warp in such a manner that for instance the first, third, and fifth warp-threads (Wa 1) pass over the lease-rod, and the second and fourth (Wa 2) underneath it. The space between the two groups of warp-threads at that side of the lease-rod nearest to the weaver is called the shed (S). Into this space the weft-thread (We) is inserted regardless of any process of intersection. In order to interlace this weft-thread with those of the warp, it is necessary for the lower warp-threads of the so-called "natural" shed (fig. 2, Sn) to be drawn upward round the axis of the weft-thread (We 1). This is done by hand with the help of loops (Lo) attached to a heald (H). Each of the lower warp-threads runs through a loop. To prevent the threads becoming entangled near the rear or warp-beam a cross-piece (Cr) is inserted. Fig. 3 shows the length of the threads when the heald is drawn up. Weft-thread No. 1 is already in position. Above the as yet horizontally stretched upper warp-thread (Wa) a new, "artificial", shed has been formed (Sa), into which the second weft-thread (We 2) is inserted. When the heald is released (fig. 4), the second weft-thread is also woven. Again a natural shed has been formed, into which the third weft-thread (We 3) is inserted. The weaver's comb (Co) is used to beat the weft-threads into position in a movement towards the front-beam, where the fabric (F) is thus formed.

In the development of weaving those looms in which the shed is formed by hand by means of a heald constitute a stage of their own. This type of loom scarcely permitted of exact, even weaving. For that reason the people of medieval Europe, the civilized nations of Asia, and the more gifted Nomads and African primitives refined and perfected the mechanism of forming the shed. It was a further progressive change when the working of this mechanism was transferred from the weaver's hands to his feet.

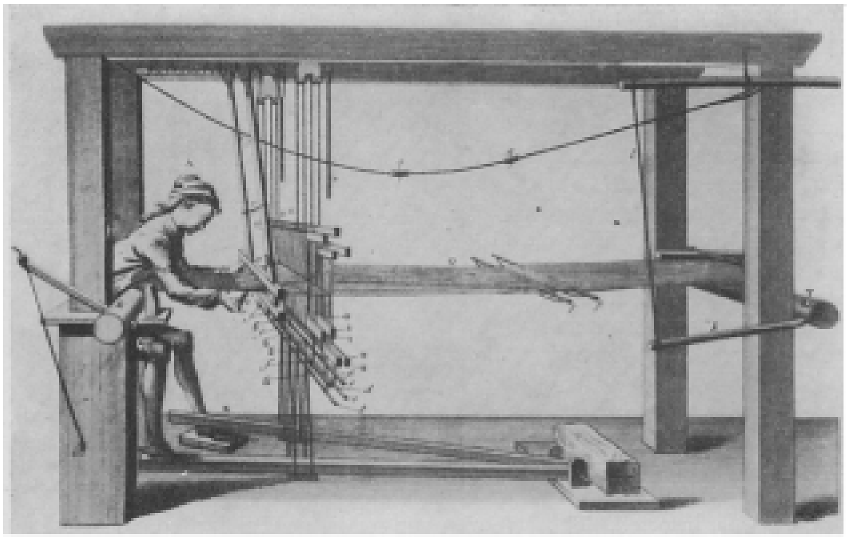


Simple loom with two pairs of shafts. The warp-threads are stretched by weights attached to the warp-loom. Batten and shedding-harness are adjustable. From "Recueil de Planches sur les Sciences". Paris 1772.

Whereas, in the type of loom described above, the loops of the shedding apparatus could only move in an upward direction, in the so-called shaft-loom the strings or healds are secured at their lower end to a second lath, by means of which they can also be drawn downward. This combination of strings and laths is called a pair of shafts (fig. 5 Sh); by means of vertical laths the shafts are connected to form a frame (fr). A second frame makes it unnecessary to use a lease-rod for

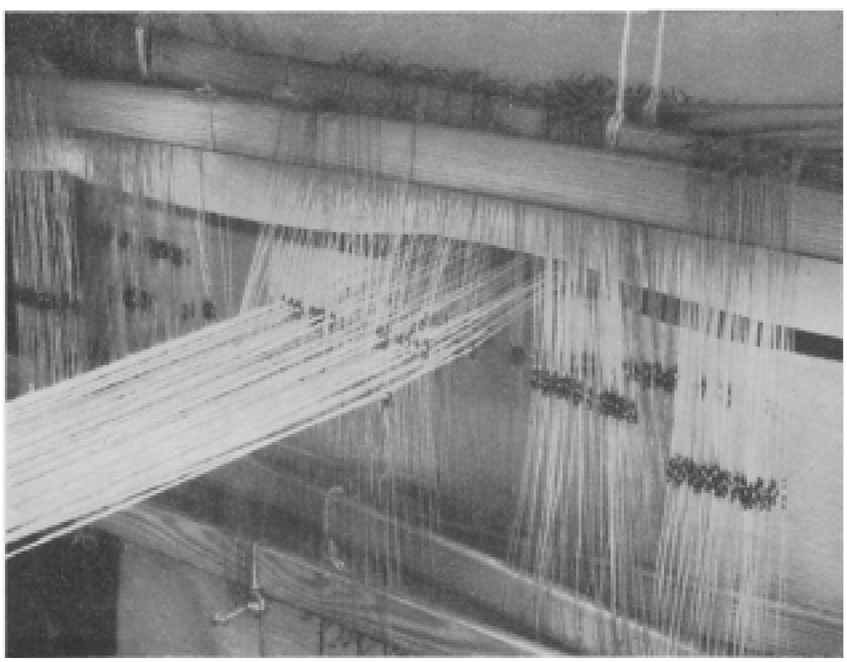


The shuttle—inserted by hand—carries the weft-thread into the shed. From the hand-weaving studio of Eleonore Hüni, Basle.

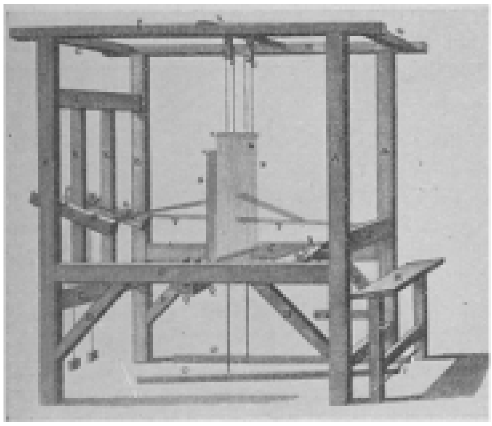


Silk loom with fourfold shedding harness. The warp is held taut by turning the beams with levers held in position by ropes. The cross-pieces inserted into the warp are plainly visible. From "L'art du fabriquant d'etoffes de soie". Paris 1777.

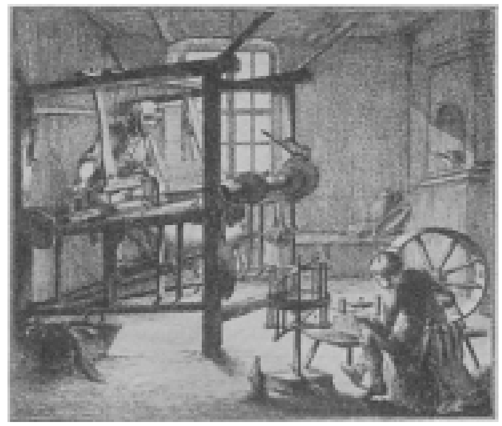
forming the shed, as all the warp-threads run through loops. For instance, odd numbers (1, 3, 5, 7, etc.) may run through the loops of the first frame, the even numbers (2, 4, 6, etc.) through those of the second. The alternate, upward and downward movement of the frames separates odd and even numbers, thus producing the shed. The cords by which the frames are suspended pass over a roller (R), and are connected with treadles (Tr). In this manner the frames are automatically raised and lowered, leaving the weaver's hands free to insert the weft-threads into the shed, and to beat down the weft towards the cloth-beam (B 1). This simple method of alternately moving the frames to form the sheds is the basis of the superiority of the shaft-loom over the type worked entirely by hand. The origin of the treadle-loom remains a matter of some doubt. As the European never made use of his feet to facilitate his work to the extent which the peoples of Asia, especially of the



Shedding-harness of a hand-loom showing the warp-threads running through the eyes of the shedding-cords. From the hand-weaving studio of Eleonore Hüni, Basle.



Formation of the shed on a simple ribbon-loom. From "Recueil de Planches sur les Sciences". Paris 1772.



Cloth-Weaver. After J. W. Meil (born 1733). In the foreground a boy spooling thread.

Far East, did, it seems probable that Asia was the original home of treadle weaving.

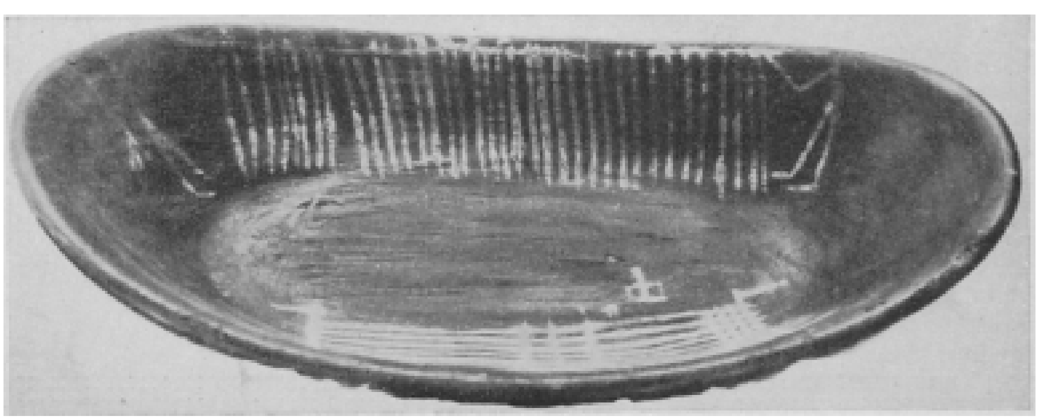
A further improvement in the loom is constituted by the batten suspended from the upper framework of the loom (fig. 5 Ba), in the free end of which the reed (rd) is inserted. The improvement, as compared with the comb (fig. 4 Co), consists in the fact that the batten is always in position, and after beating the weft is swung back by its own weight, thus making way for the shuttle to pass through the shed. Fig. 5 is a diagram of a fully developed treadle-loom complete with batten. The improved system of shedding without doubt increased the precision of the loom, which did not, however, in all cases result in finer fabrics. Such examples as have been preserved show that in spite of their primitive instruments the weavers of the Ancient World produced veritable marvels of the textile art.

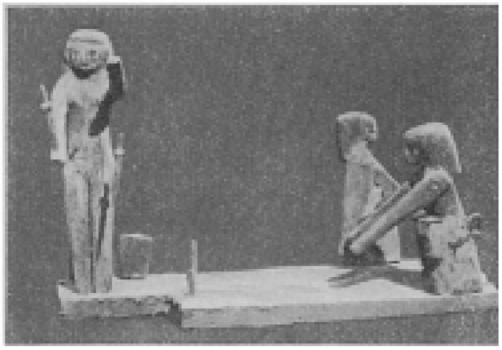
The Loom of Ancient Egypt

By G. Schaefer

The earliest records of weaving in Europe date from prehistoric times. In swamps, mines, and the bog-engulfed pile-dwellings of the Later Stone Age, traces of linen and woollen fabrics have been found. In similar manner the textile finds of Ancient Egypt, where weaving was very highly developed, can be traced back to a period not earlier than the neo-palaeolothic age. In graves of the Egyptian Badari era, which probably lasted until about 3400 B.C., excavators have not only found fragments of cloth, but also a drawing of a loom on the inside of a flat bowl of the same period. The oval dish, now in the possession of the Department of Egyptology in the University of London, came from Badari (or Bedari) in Egypt. On the side nearest to the camera (see ill.) a horizontal loom may be distinguished. The short upright posts supporting the warp and cloth-beams are turned round 90 degrees, as the Egyptians knew nothing of perspective. In the drawing the warp-threads are indicated by a few thick strokes. The three lines crossing the warp in the centre are probably intended to represent the rod used for keeping the warp threads in position, the shed-stick for producing the shed, and the rod heddle for the counter-shed. The three transverse lines close to the cloth-beam (right) are without doubt the woof-threads pressed into position to form the fabric by means of a sword or beater-in. What the figure beside the loom signifies, it is not easy to say. It is perhaps a remnant of what was intended to denote the weaver squatting by his loom. The drawing on the other side of the bowl, which shows two human figures devoting their attention to what appears to be a cross-beam hung with broad band-like objects, has not been adequately explained. How rash it is to judge from primitive looms or from the fact of no loom being preserved, that a nation was ignorant of, or backward in the art of weaving, is demonstrated by the fact that no trace or record of any loom has been preserved from the more than 1000 years of the Old Kingdom of Egypt. Though this period is a blank in the history of the loom, it was a period in which weaving flourished. The fragments of cloth belonging to the First Dynasty are of surprisingly fine quality, and we are told that in the Sixth Dynasty there were robes of so delicate a texture that they could be drawn through a signet-ring. The so-called Byssus fabrics, which were said to cover the body and at the same time to enhance its lines, were affected by the nobility. That Byssus robes remained popular in the New Kingdom is shown by the magnificent relief on the back of the throne of Tut-ankh-Amon (ca. 1350 B.C.), where the queen is seen wearing one of these airy, web-like dresses. From the time of the Middle Kingdom on (2160–1788 B.C.), our knowledge of Egyptian weaving becomes more detailed; it is not only based on several drawings of looms and numerous fabrics, but on actual models of looms, which solved the

Flat bowl found at Badari (Central Egyp) with drawing of an Ancient Egyptian horizontal loom. 4 thousand years B.C. *Department of Egyptology, University of London.*





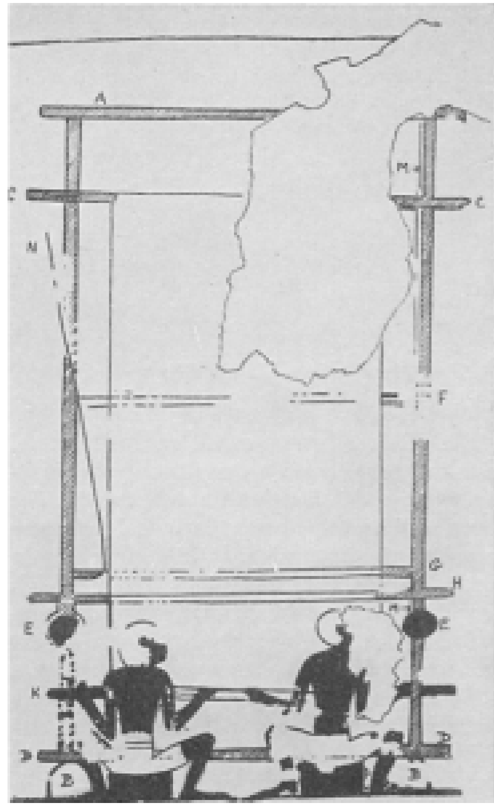
Model of Egyptian loom. Middle Kingdom (2160–1788 B.C.). Found by John Garstang. Liverpool Museum.

riddle of their construction, and put an end to a controversy which could only be fruitless without definite proof on either side. The remains of a badly damaged model loom were found by the Egyptologist John Garstang in tomb No. 575 at Beni Hassan. The model is now in Liverpool Museum. Of the loom itself all that remains are the short stakes driven into the ground, which supported cloth-beam and warp-beam. The parallel lines of the sketch by Miss Davey appear to be a reconstruction indicating the run of the warp. There can, however, be no doubt of the fact that this loom from the Middle Kingdom must have been a horizontal one. It is probable, though not evident from the model, that shed-stick and rod-heddle were used to form the shed. The answer to this question which is of great importance for the history of the loom is provided by a valuable find of the expedition to Egypt of the Metropolitan Museum of Art, New York. In the grave of Mehenkwetre near Thebes a model of a loom was discovered (cf. Ciba Review, No. 12, p. 401). Nothing could have recorded more vividly than this model the technique of weaving in the Middle Kingdom. Dainty Egyptian women are depicted, spinning, warping, and weaving. The weavers sit at a low loom on the ground. Cloth and warp-beams are on a level with the ground, and are held in position by pegs. Immediately in front of the warp-beam a cord runs through the warp to prevent the threads from becoming entangled, a function taken over by a rod at a later period. The shed is formed by shed-stick and heddle. The weft is driven home with the sword or beater-in. From the fragments of cloth preserved from this period the width of the materials made on these looms is estimated at 5 or 6 feet. Fabrics of such dimensions made it necessary for more than one person to tend the loom, not counting those who spun the thread or prepared the warp-thread with the help of an ingenious contrivance of three pegs attached to the wall. This rare piece of Egyptian modelling seems to mirror a life of happy and industrious work, yet a contemporary papyrus describes the weavers' lot as anything but enviable. One of the most controversial weaving-pictures of the Middle Kingdom was that from the tomb of Chmen Hotep at Beni Hassan (cf. Ciba Review No. 12, p. 401), which belongs to the 12th dynasty (from 2000 to 1788 B.C.). The drawing is executed without regard to perspective, and gives the impression of reproducing a high-warp loom. It is in reality a horizontal loom operated by two women. They are seated on either side of the loom to enable them to move with the cloth as it extends towards the warp-beam. The woman on the left holds the shed-stick, in front of which is the rod-heddle. By means of a ponderous sword the weft is beaten into position. Before the warp-beam a cord is visible which serves to keep the threads from becoming entangled.

The transition from the looms of the

Tut-ankh-Amon (ab. 1350 B.C.) with his queen. The queen is wearing a robe of Byssus fabric.

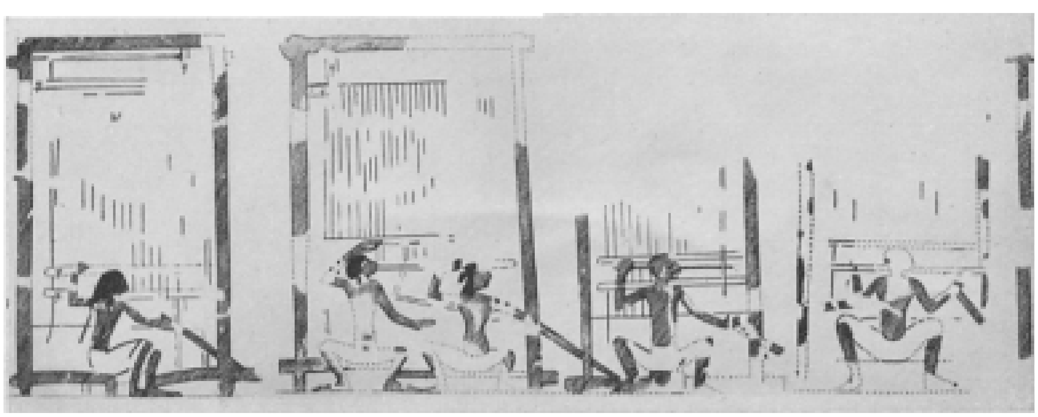
Middle Kingdom to those of the New Kingdom cannot be traced in detail, as the necessary links in the chain are lacking. It is noteworthy that in the New Kingdom (1580–712 B.C.) we invariably meet with a vertical loom of considerable size. This vertical loom is technically more developed. The warp-threads are not held taut by means of weights as was the case with the Greek loom; instead, they are attached to a lower cross-tree. This type of loom is known as a tapestry-loom, as it was the kind used in European tapestry-weaving. In the tomb of Thot-nefer, a Royal secretary, N. de Garis found pictures of two vertical looms of imposing size. The weavers worked singly or in pairs at these looms. As the fabric extended in an upward direction, there must have been a limit beyond which the weavers could not reach. It has recently been conjectured that the finished portion of the fabric was rolled round the lower or cloth-beam, and that the warp-beam could be adjusted by means of ropes. The black discs on either side of the frame are believed to be appliances for adjusting the ropes. The shed is formed by means of shed-stick and rod-heddle, which are seen above the heads of the weavers. For keeping the shed open for longer periods a board was used, which the weavers are believed to be seen holding as they squat on a species of hassock. The murals in the tomb of Nefer-ronpet, head of the weavers of Thebes, show a number of looms dating from about 1200 B.C. The drawings are too sketchy and too badly damaged to convey much information as to the Egyptian vertical loom. Weaving was practised both by men and women in Ancient Egypt. Whereas the men are drawn



Vertical loom. After a painting in the tomb of Thot-nefer, Thebes. Found by N. de Garis.

as sitting with their knees wide apart, the woman in the picture is sitting in a sort of side-saddle attitude, legs together, in the manner which is in the East to this day considered the only becoming way for women to sit. Among the many modern attempts to re-

Painting showing a weaver's workshop from the tomb of Nefer-ronpet, head of the weavers. Thebes, 1200 B.C.

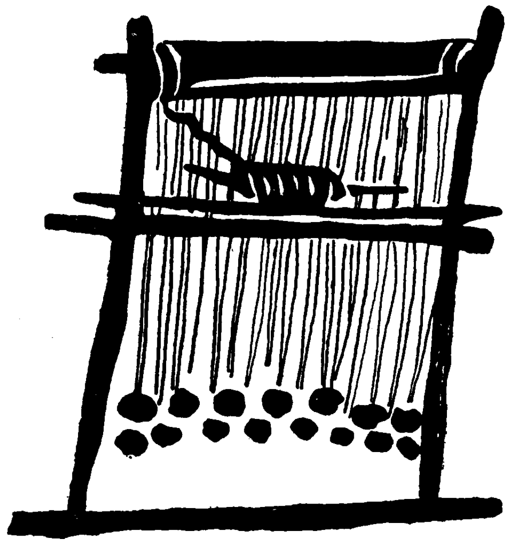


construct the vertical Egyptian loom that of the archaeologist C. H. Johl may be mentioned. His model is in the Egyptian department of the State Museums, Berlin (cf. Ciba Review No. 12, p. 402). The model is built on the lines of the looms in the tomb of Thot-nefer at Thebes: the cloth-beam can be turned by means of a crank. The transverse rod, which in the photograph is much too high, is the shed-stick; the lower rod is the heddle, the loops of which are visible as a tangle of threads. The broad lath is for keeping the shed open.

Greek and Roman Looms

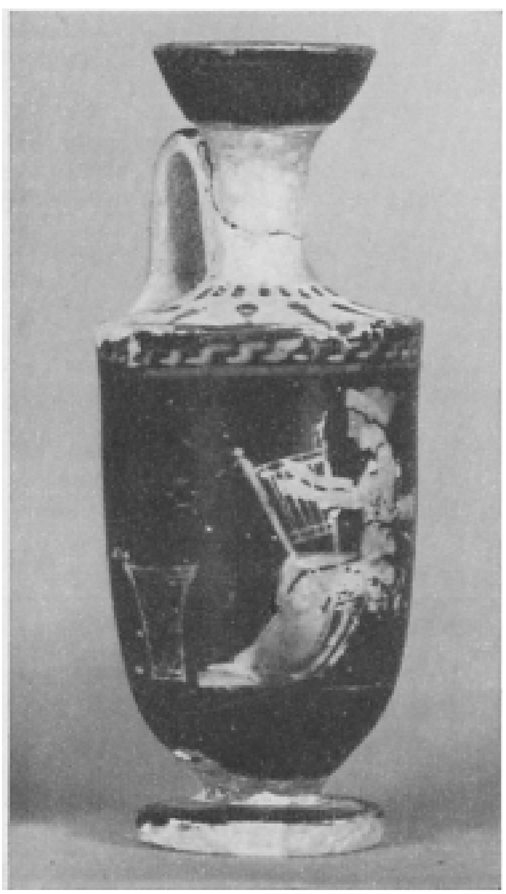
By G. Schaefer

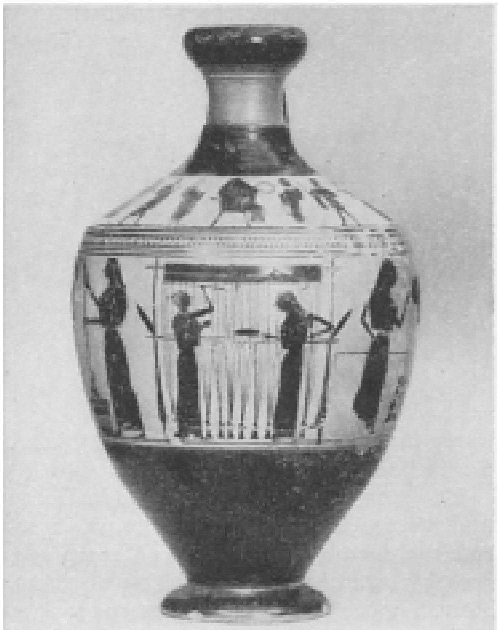
Whereas in Egypt weaving was carried on in comparatively large, factory-like workshops, in Greece it was a domestic occupation for women. The manner in which weaving was regarded socially seems also to have differed in the two countries. In Egypt it was principally an occupation for slaves, whilst in Greece and Rome women of the highest rank did not consider weaving beneath their dignity. Even goddesses are depicted as working at the loom. Though the pictures which show women working at a tapestry or embroidery-frame are not exactly frequent (examples are scenes depicted on an Attic drinking-vessel and on a Lekythos vase from about 500 B.C.), they are sufficient to convey a fairly adequate impression of what the Greek loom, which was part of the regular household furniture, was like. Looms are frequently seen on reproductions of scenes in the palace of Circe, or of Penelope's life in the house of Ulysses. The looms shown are without exception of the vertical type in its simplest form, the warp stretched with weights of stone or clay. A black-figured Archaic vase-painting of the 6th century B.C. (original in the Metropolitan Museum of Art, New York) gives a vivid impression of the Greek loom, which remained unchanged for centuries. It consists of a cross-piece supported by two vertical posts which taper upwards. From the cross-tree the warp-threads hang down. Below the shed-stick they are caught into bundles, and held taut by weights. Two girls are working at this loom. The threads of the weft are inserted by means of spools, and beaten into position with a weaver's comb. The fabric takes shape above the heads of the two girls, underneath the cross-beam. Of especial interest is a grotesque, black figured vase-painting of the 5th century B.C., which shows a by no means heroic-looking Ulysses in the company of a singularly unattractive Circe. In the illustration above only the loom is reproduced. The exaggeration of its principal elements is characteristic. An enormous spool of thread indicates the most important attri-



Greek loom. 5th century B.C. From a Boeotian skyphos showing Ulysses and Circe. Note the oblique position of the loom, which had definite technical reasons.

Athenian girl weaving. Lekythos vase about 500 B.C. British Museum, London.





Greek women weaving and spinning, on a black-figures vase, 6th century B.C., *the weights attached to the bundles of warp-threads are very plainly to be seen. Metropolitan Museum of Art, New York.*

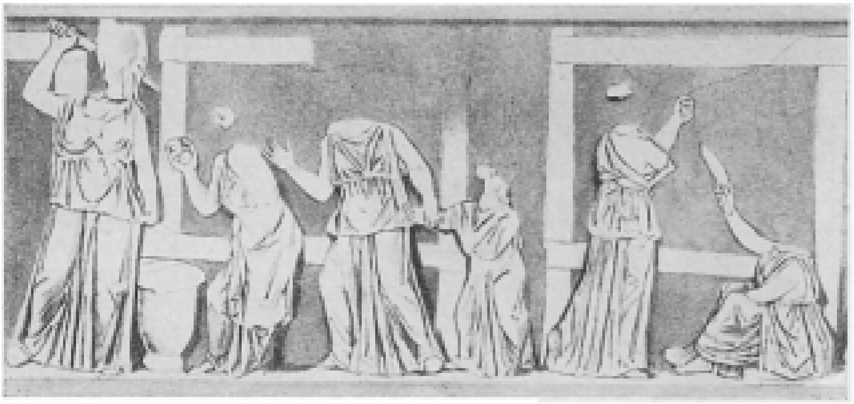
bute of weaving. A thread leads with technical correctness from the spool to the finished cloth on the loom. Shed-stick and rod-heddle form the shed, which to judge by the unequal height of the warp-weights, is open. The pronounced inclination of the frame towards the right is by no means accidental. Experts of weaving have pointed out that the tension of the warp-threads is increased by this lateral inclination, and the re-formation of the shed is facilitated.

The classical picture of a loom in Greek art is to be found on a skyphos vessel from Chiusi, which dates from the second half of the fifth century B.C. The group showing Telemachos and Penelope is perfect in its execution (cf. illustration below). The loom, which is taller than a man, and has room for two weavers to work, serves as a decorative background for the figural scene. In view of the size of the loom, it is not surprising that it has a special beam for the cloth as well as the cross-piece at the top of the frame. The balls attached to the cross-beam are regarded as spools of thread. The posts of this loom, too, grow thicker towards the bottom, and are driven, peg-like, into the floor. The few pictures of Greek looms, all of which belong approximately to the same period, reveal a similar construction, in which the shed is formed by pulling out the loop-rod with the hands. This makes it possible to abandon at anytime the orthodox principle of weaving, which consists in passing weft-thread across the entire breadth of warp, and to pass it only through a certain number, a method more akin to embroidery than weaving.

That the Greeks were able to produce figured as well as plain cloths seems indicated by the legend of Philomele, who was ravished and rendered dumb by the husband of her own sister. She wove the story of her wrongs on her loom, and sent it to her sister.

How difficult it is, to winnow the actual facts from the evidence which has come

Penelope and Telemachos before a high-warp loom, showing an unfinished tapestry. So-called Penelope vase from Chiusi, dated about 400 B.C. *Red figures on black ground.*



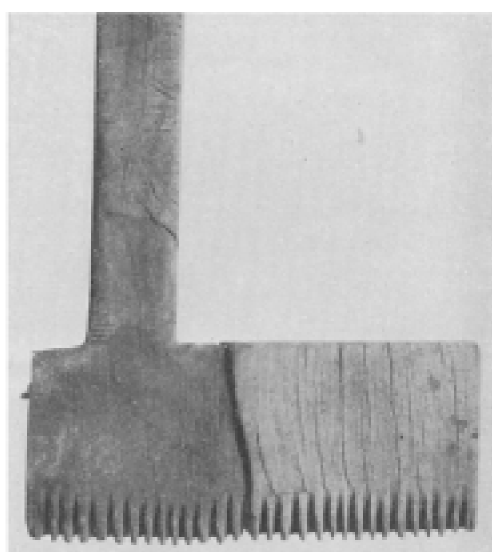
Weaving relief from the Nerva Forum, Rome. End of 1st century A.D. *From "Monumenti Inediti". Rome 1878.*

down to us, is shown by the example of a classical vase taken from Atti della Reale Accademia dei Lincei 1904, p. 199. It shows a loom, and adds by way of technical detail a cross-section to demonstrate the formation of the shed. There can be no doubt that the draughtsman made a mistake, for he did not hesitate to let the warp-threads, to which weights should be attached – end in a piece of finished fabric.

Illustrations of Roman looms are few in number. They were of the vertical type, but differ from those of Greece inasmuch as the warp was not kept taut by weights, but by means of a lower cross-beam. They were tapestry-looms, after the manner of those of the New Kingdom in Egypt. Wether the Romans adopted this type from Egypt, is not precisely known. There is, however, no doubt that they prized Egyptian textiles inordinately. The finest linen fabrics in Rome came from the Nile valley. In Rome as well as in Thebes weaving was carried on by slaves on a large scale. The looms on the reliefs of the Nerva Forum in Rome (end of 1st century A.D.), which unfortunately are very much defaced, reveal a size and solidity well adapted to large scale production; and this conclusion is supported by a fragment of a massive weaver's comb preserved in Bankfield Museum, Halifax. As well as Roman looms for industrial weaving, there were lighter ones of the same type for domestic use. A miniature in the Virgil manuscript of the Vatican Library, dating from the time of Septimius Severus (about A.D. 200), gives an illustration of Ulysses' sojourn with Circe, on which a Roman domestic loom may be seen. The warp-threads with top-beam, lower beam, and shed-stick are easily distinguished. Precisely the same type occurs on the tomb of Severa Seleuciana (A.D. 279).

The period of the Renaissance in Europe and the two succeeding centuries, which as a rule were wont to take things Roman as an example, were not impressed by the simple Roman tapestry-loom. A reconstruction of the Roman loom, which found a place in the Vetera Monumenta Romae, 1690, shows how the 17th century, with its own treadle-loom, would have liked the Roman loom to be. What had never been possible in the history of the loom was accomplished here: by means of a complicated system of ropes, levers, and rollers, the vertical loom was transformed into a treadle-loom. Even in the 19th century this bold attempt occupied the minds of experts.

Roman weaver's comb. Bankfield Museum, Halifax.



Neolan Navy Blue 2RL Conc.

Neolan Black WA extra N

Simple application

Good levelling

Retention of handle

Very good fastness to light and decatising

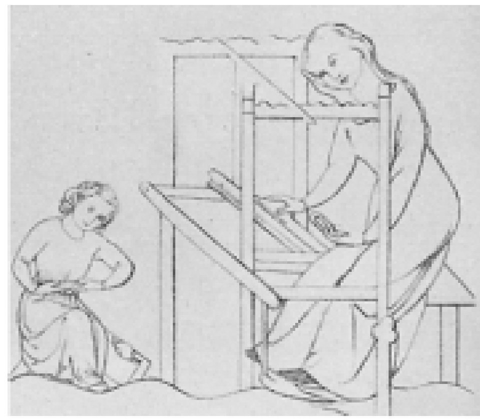
Good reservation of cotton, viscose rayon and acetate rayon

The Hand-Loom of the Middle Ages and the Following Centuries

By G. Schaefer

The vertical loom as known in Egypt, Greece, and Rome, was familiar to medieval Europe, but did not become prevalent. Whether it was generally used before the Crusades (1096), is, like many other matters of early medieval history, not certain. A miniature in the Eadwine's Psalter, a Cambridge Ms. of about 1150, shows a vertical loom. As a domestic instrument it was still in use at the end of the Middle Ages, as would appear from an engraving by Hans Leu, "The Virgin Weaving", 1510. The vertical loom had its great period in the 18th century. As it was almost exclusively used for tapestry-weaving, it does not fall within the scope of the present discussion.

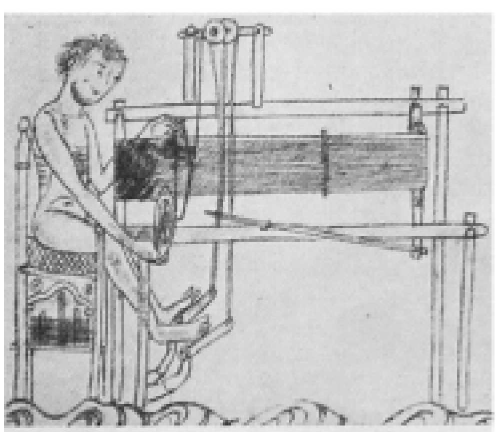
European weaving from the 13th century onward is characterized by the use of the treadle-loom with horizontal warp. The links which would connect this highly perfected type with the primitive hand-loom are missing. The treadle-loom appears in Europe as a perfected invention, and as its most highly developed form, the draw-loom, certainly came from the East, the idea of the treadle-loom itself probably originated there, too. A 13th Cambridge manuscript reproduces with unusual distinctness a treadle-loom with all its essentials. The weaver sits naked at his loom, a horizontal frame of a height convenient for him to work at. The warp-



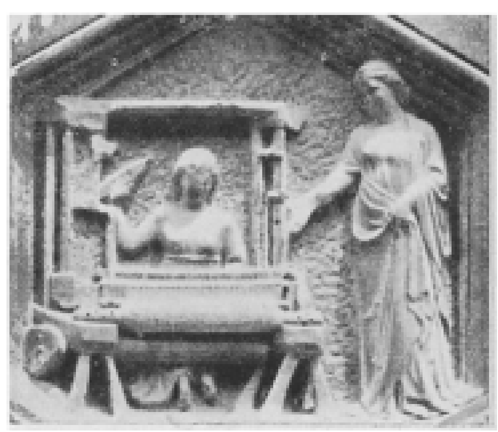
Fresco showing loom. Constance, early 14th century. The loom has the high frame form and is fitted with a batten. A child is spooling thread.

threads are kept taut by means of a lever attached to one end of the warp-beam, the other being fast to the frame. This lever or rod exerts pressure against the free end of the warp-beam, thus keeping the warp-threads taut, yet at the same time allowing for a certain elasticity. This detail is typical of linen looms, and has maintained itself even to the present day. The feature which distinguishes the treadle-loom in particular, is, however, the formation of the shed, the raising and lowering of the shedding harness by means of

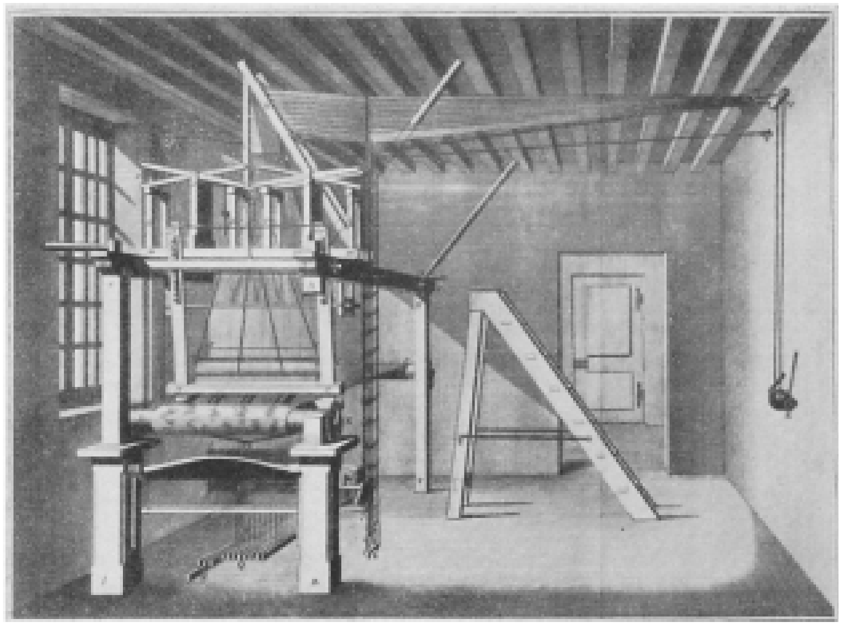
Naked weaver at a treadle-loom with shedding-harness. Thirteenth century. From a Manuscript in Trinity College, Cambridge.



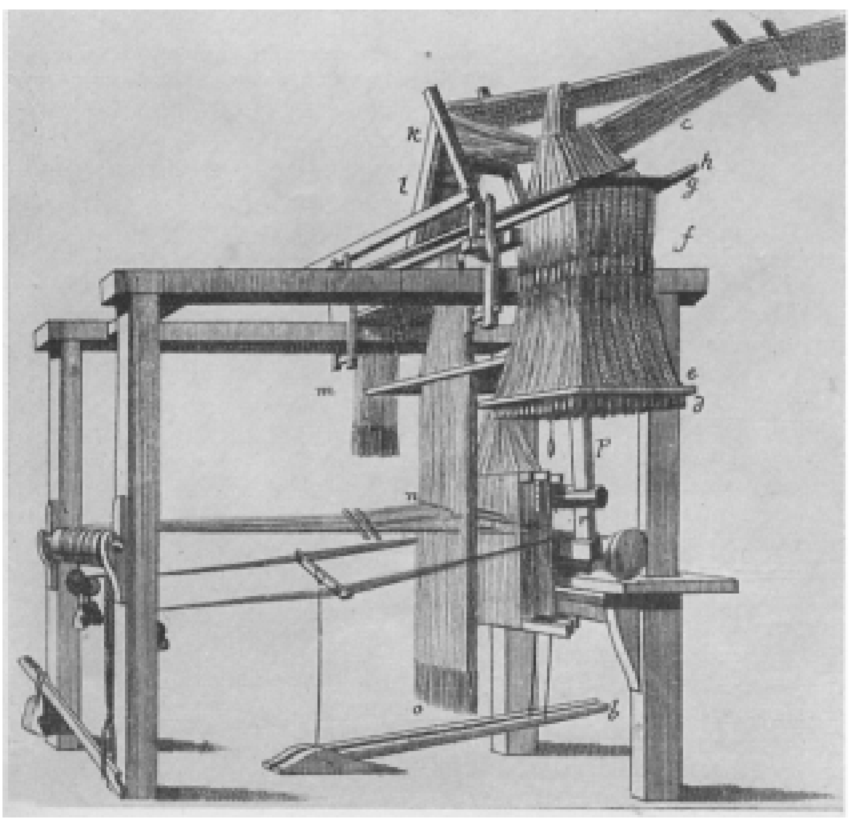
Weaver at work. The shafts hung with cords may be distinguished quite plainly. Bas relief by Giotto and Pisano. 14th century. Campanile of Florence Cathedral.



Draw-loom for the manufacture of figured fabrics. The system is similar to that of the button-loom below, but the cords hang in groups manipulated by another system of cords, instead of terminating in buttons or lingoes. From "Recueil de Planches sur les Sciences". Paris 1772.



treadles. For that purpose the loom has a top frame, equipped with rollers over which cords run from the shedding-harness to the treadles. The unskilled artist of the 13th century did not quite succeed in drawing this mechanism in its true perspective; that is not



So-called button-loom for the manufacture of figured silk fabrics. In front is the button-board with buttons. The loom has two pairs of shafts. From Hallens, "Werkstätte der heutigen Künste." Leipzig 1761.

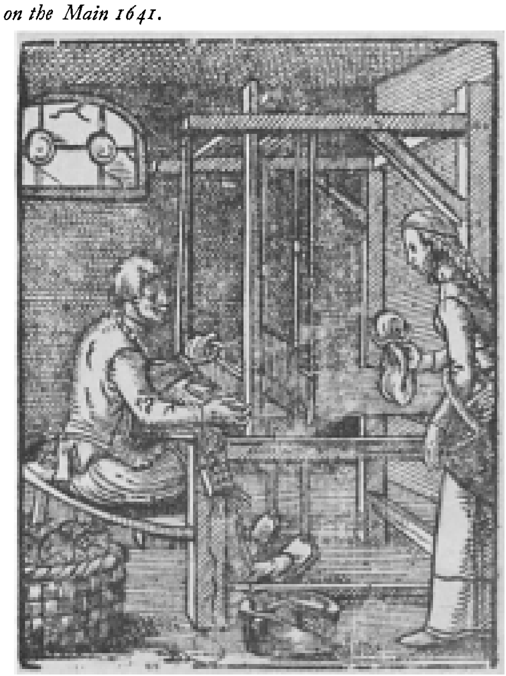
Old man at the loom. The shedding harness is suspended from the ceiling. The weaver works barefooted. Nuremberg painting, 1387.

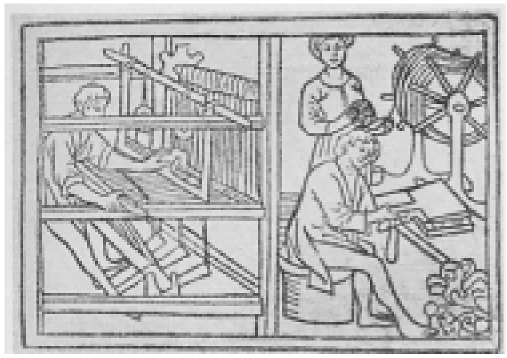
surprising, as it has baffled better draughtsmen than he. The insertion of the weft-thread into the warp is, however, very plain. In his right hand the weaver holds the shuttle containing a spool of thread, and passes it rapidly through the open shed, his left hand open to receive it. A Nuremberg painting of 1387 shows a barefooted old man weaving. The treadle-loom has two pairs of shafts, the rollers, over which the cords for raising and lowering them run, being attached to the ceiling. The balls of thread seen in the picture are slightly exaggerated in size; they were often used as attributes of weaving, to indicate that there was work in plenty for the loom. The heavy, closed frame for the loom became common in the 15th century. This made it possible for a further technical innovation to be introduced, the heavy batten, which swung from the top of the frame (see title-page). Its lower part contained the reed with which the loosely woven weft-thread was beaten into position. The teeth of the reed, often more than 1000 in number, were of reeds or rushes (arundo phragmites). In the case of silk-weaving, where the weft-thread is wet when inserted, the reed was made of flattened wire, a device introduced by John Kay, the inventor of the fly shuttle.

The medieval loom as it is reproduced by innumerable reliefs, paintings, and drawings, still persists in its principal elements in the mechanical looms of today. In accordance with the varying kinds of cloth, various types of looms developed, the most important being the linen-loom, the cloth-loom, the silk-loom, the damask-loom, and the loom for the weaving of piled fabrics. The latter is equipped with a second warp-tree to accommodate the pile warp. The intricacy of the fabric is plainly reflected by the number of shafts. A linen-loom has 2, a fustian-loom 3 or 4, other looms as many as 24 pairs of shafts.

While shaft-looms were adequate for plain cloths, other methods had to be devised for the weaving of figured fabrics, which would have required more than 100 pairs of shafts. The so-called draw-loom was devised to make up for the deficiencies of the shaft-loom in the manufacture of figured fabrics. Each separate shed was produced by the draw-boy; on the button draw-loom and the simple-loom an intricate system of threads

Cloth-loom, 16th century. The loom, which has two pairs of shafts, stands in a dark, cool room. The woman is bringing thread for the pick. From "Piazza Universale". Frankfort on the Main 1641.





Treadle-loom with batten. From Rodericus Zamorensis, "Spiegel des menschlichen Lebens" (Mirror of Human Life). Augsburg 1477.

and cords made it possible for the draw-boy to pull the cords required for the pattern, without his even being skilled in weaving.

The button draw-loom, the commonest loom for silk-weaving derives its name from the buttons or lingoes (as many as 300), which are in charge of the draw-boy. The warp-threads are raised by separate cords gathered into groups as required by the pattern. These are carried upward, over rollers, and after being carried horizontally for some distance they are fixed to the wall. From each of these groups a cord is suspended. According to the pattern, different cords are taken together, passed through a comber-board, and the weights or buttons are attached to them. In the simple-loom generally used for damask and moiré, the cords extend to the ground, and are not weighed. By joining certain cords, groups are formed, which when pulled, open the shed as the pattern requires. These draw-looms were common in Europe until about 1800.

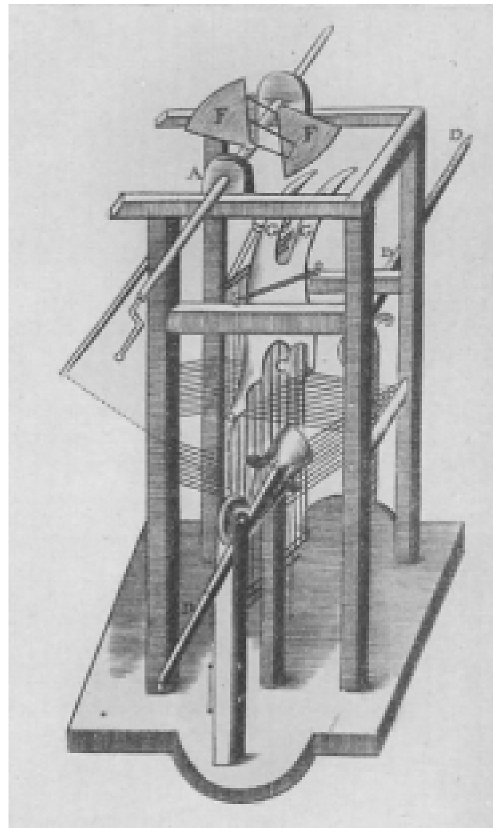
The Mechanization of the Loom

By G. Schaefer

Mechanization (from Greek "mechané" = machine) may be defined in general terms as transferring the manual operations of the workman to a more or less intricate system of rollers, levers, etc., it being only necessary for the driving power to operate in one direction. Though the treadle-loom with its shedding-harness of levers, ropes, and rollers, is beyond question a mechanical device, the loom remained for centuries in a stage of partial mechanization, so that the period of mechanical weaving cannot be said to have begun before the 19th century. In the East, where a thousand years count no more than a day, the partially mechanized loom is, with some exceptions, still in exclusive use. It was reserved for Europe to take the lead here as in other technical matters, and in the course of two centuries to complete the mechanization of the loom, finally even to render it automatic.

Leonardo da Vinci (1452–1519) was one of the first who occupied themselves with mechanical looms, but his plans were never realized. It is customary to count the invention of a practical mechanical loom among the achievements of the 19th century. There is, however, no doubt that this ambitious project was first realized at the end of the 16th century. In 1586 Anton Möller of Danzig is said to have invented a mechanical ribbon-loom which could be operated by an unskilled attendant, who supplied the necessary power by working a lever. This story has not been proved, but several edicts against the use of such ribbon-looms from the early 17th century preclude all doubt in their existences.

The reason for the decrees against such looms was that they rendered the weavers workless; Möller himself is said to have been drowned in the river Weichsel by the infuriated craftsmen. Though the problem of weaving smallware, such as ribbons, tape, etc, was thus practically solved, two centuries passed before it was possible to produce cloths of greater width in such quality as could vie with the products of the hand-loom. This was not through lack of endeavour. In 1678 a naval officer named de Gennes (died ab. 1705) published a design for a mechanical loom. He laid stress on the fact that it was a machine that could weave without human assistance. The loom was to be driven by means of a shaft rotating by waterpower. One mill could drive ten or a dozen looms, and de Gennes claimed to have evolved a device which would make it possible to close down one or more looms without interfering with the working of the others. De Gennes displayed his mechanical talents in a number of other inventions. He invented special arrows to tear the sails of enemy ships, constructed clocks without weights, and an automatic peacock! His statement that his loom could produce cloth of any width, does not seem to have been fulfilled, at any rate, we know nothing of it ever being used. The dream of the automatic loom was not to be realized yet, and the attempt made in 1745 by John Kay, the inventor of the fly-shuttle, together with Joseph Stell was also unsuccessful.

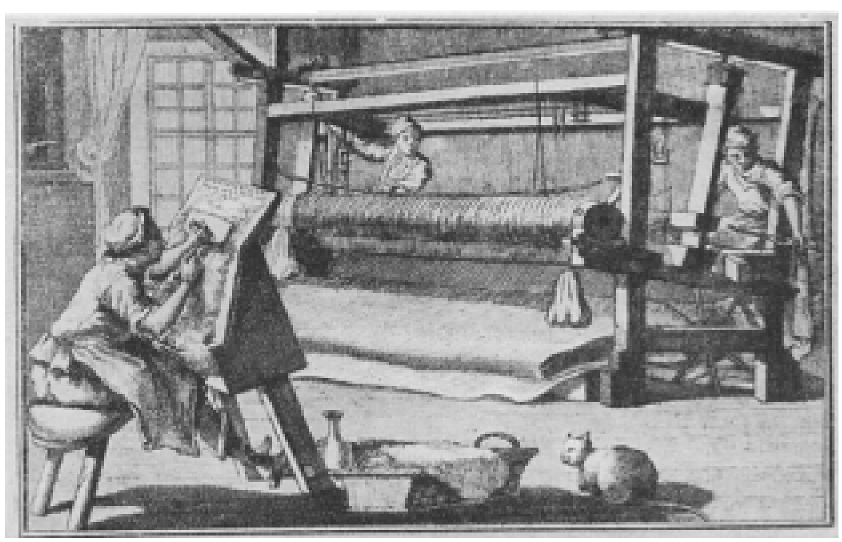


The first attempt to construct a mechanical loom by the naval officer de Gennes (died ab. 1705). The machine was driven by a revolving shaft. From "Philosophical Transactions", London 1683.

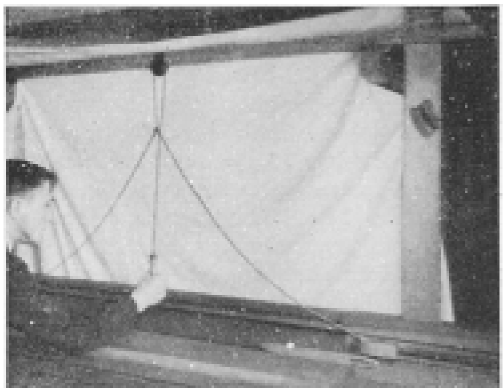
John Kay (died about 1774), the inventor of the fly-shuttle. After the portrait by T. O. Barlow (1824–1889). British Museum, London.

What made the reed-maker John Kay famous beyond the shores of England was the mechanization of one of the most important operations of weaving, of the pick. The traditional method of passing the shuttle through the shed by hand was slow, and required two weavers for the making of broad pieces of cloth. The principle of Kay's fly-shuttle is that of the catapult. A picker or driver, set in motion by a suddenly tightened cord projects the shuttle. The picker is brought to an abrupt standstill after a short passage, thus shooting the shuttle through the shed. The shuttle is guided by the shuttle-race, a ledge of the batten running beneath the lower warp-threads. Kay's invention of 1733 was popular with the manufacturers, but a severe blow to the small weavers. In 1753 they stormed his house with the intention of killing him. Hidden beneath a heap of waste wool, Kay barely escaped with his life. Invention seems to have run in this family from Bury, Lancashire. John's son, Robert, invented the multiple shuttle-box in 1760, probably in collaboration with his father: this made it possible to apply the principle of the fly-shuttle to any required number of shuttles bearing coloured thread for the manufacture of different coloured fabrics.

Edmund Cartwright (1743–1823) was a theologian and something of a poet, and knew nothing about weaving, as he stated himself. It was due to his liking for mechanical problems and his perseverence and energy that he became the inventor of the mechanical loom which in principle has held its own to this day. In a letter to a Mr. Bannatyne, Cartwright himself explained the circumstances which led to his invention. In the summer of 1784 he was present during a conversation between textile manufacturers from Manchester. One of the latter maintained that when Arkwright's patent expired so many mechanical spinning mills would be set up that the thread could never be absorbed by the weavers. Cartwright denied that, and maintained that it would be Arkwright's place to provide a mechanical loom. Experts de-



Loom requiring two men to work it. From Hallens, "Werkstätte der heutigen Künste". Leipzig 1761.



Fly-shuttle of a modern hand-loom. The fly-shuttle was invented in 1733 by John Kay (1704–ab. 1774). From the hand-weaving studio of Eleonore Hüni, Basle.

clared such a thing to be impossible, whereupon Cartwright rejoined that he had recently seen an automaton in London which actually played chess, and that it should not be more difficult to reproduce the simple process of weaving than that of playing chess, which is infinitely more involved. This argument was not very sound, as the mechanical chess-player was in reality an apparatus with a man inside it. Nevertheless, Cartwright set to work, and began to ponder the process of weaving, which he divided into three simple movements. His plans were carried out by a carpenter and a blacksmith, and he soon produced a loom, upon which cloth really could be woven, though considerable time and power were expended in the process. Though by no means perfect, this loom embodied the principles of mechanical weaving, and Cartwright took out a patent on April 4th, 1785. Only then did he begin to study practical weaving and the looms of the period, which inspired him to various improvements of his original model. After two year of hard work he produced the loom specified in the patent of 1786. Shedding, picking, and beating-up are mechanized by a system of cog-wheels, worm-gears, etc., into one homogeneous motion. A device for stopping the loom in case of warp or weft breaking made it possible to turn the mechanical loom to practical account. Soon Cartwright himself had 19 power-looms running. Power was first supplied by an ox harnessed to a capstan, later by a steam-engine. Cartwright received no better treatment than John Kay. In 1791 the first power-mill of the firm of Grimshaw, Manchester, was destroyed by fire. After the expiration of the patents, the invention passed into the hands of energetic business-men, and it was soon installed everywhere. In 1809 Parliament voted the inventor a grant of £ 10000.

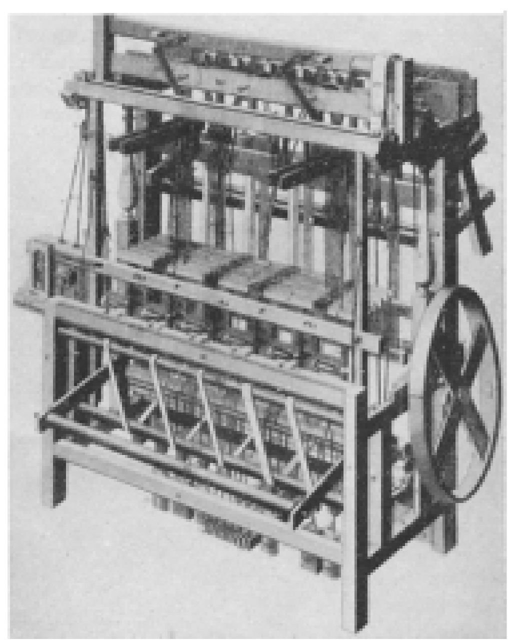
Horrocks of Stockport devised improvements of the power-loom, which in 1813 was already an important factor in the English cotton-industry. From 1822 on, the production of power-looms was promoted by Roberts of Manchester, and the looms made by the firm of Sharp and Roberts found their way to all parts of England, Scotland, and France.

The rapidity with which the mechanical loom secured a dominating position in the British textile industry is illustrated by the following facts laid before Parliament in 1830 by R. A. Slaney.

In 1813 2400 looms were in use altogether, in 1820 there were 12150 in England and 2000 in Scotland, in 1829 45500 and in Scotland 10000. The greatest increase in England was in 1824/25 and 1832/33, in Scotland in 1828 and 1832. For 1833 Edward Baines estimated the number of looms as 85000 in England and 15000 in Scotland.

The saving of time and labour made possible by the introduction of mechanical looms

Ribbon loom, on which 5 ribbons could be woven simultaneously. From "Recueil de Planches sur les Sciences". Paris 1772.



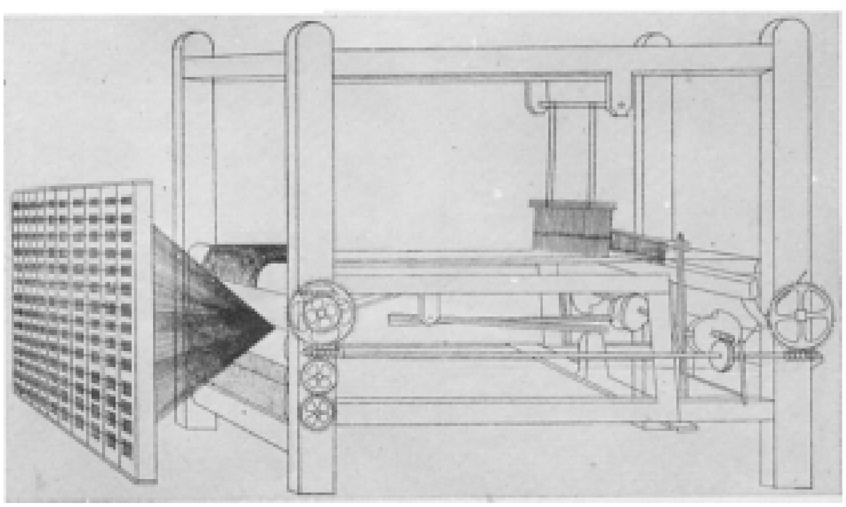
Edmund Cartwright (1743–1823). Inventor of the power-loom.

is illustrated by the following figures given by Baines.

A good weaver of 25–30 years working a hand-loom could produce two pieces of 9/8 shirting with thread No. 40, each piece 24 yards long and having 100 shoots of weft per inch. In 1823 a boy of 15 could tend two steam-looms producing seven pieces in the same time; and in 1833 a boy working four looms with the help of a girl of 12 could turn out 18—20 lengths per week.

In France, the land of figural weaving, the activities of the inventors were directed to the mechanization of the shedding-process, which presented the greatest difficulties when working a draw-loom. By arranging the strings as required, the button or lingoe-loms were prepared to suit every detail of the pattern, and the draw-boy was able to carry out his duties mechanically. In an age when the construction of "mechanical men" was a serious proposition, it was not surprising that every effort should be made to replace the draw-boy by a suitable mechanism. The principle of mechanizing the lifting of warp-threads to meet the requirements of the pattern is purely mechanical, and has nothing to do with weaving. Drawing the strings was rendered mechanical and selective by means of a perforated board or a drum with small pegs or teeth projecting at given spaces, which made it possible to draw or omit certain cords, as desired

All the efforts of the 17th century to solve the problem, from those of Basile Bouchon (1725), Falcon (1728), and others, to the invention of the so-called drum-machine and the linen-machine, were without success. Even the loom constructed in 1745 by Jacques de Vaucanson (1709–1782) an inventor famous for his mechanical marvels (among them an automatic flute-player and an automatic duck), was only recovered from oblivion by accident. Vaucanson was feared and hated by the weavers, as they thought he could make artificial workmen. The creator of "mechanical men" was received with showers of stones when he went to Lyons. Vaucanson avenged himself in a characteristic fashion. He constructed an automatic weaver in the shape of an ass, which actually did make cloth.

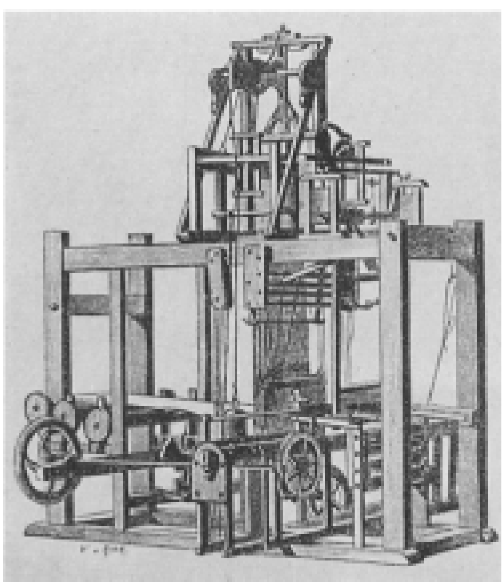


Drawing of Cartwright's mechanical loom. Note that the warp-spools are mounted on a separate frame. From the patent specification of 1786.

It was Jean Marie Jacquard (1752–1834), who constructed a really practicable automatic shedding-machine. From his early childhood he had been acquainted with the draw-loom, and he made it his object to mechanize the task of operating the shedding-harness, a task performed exclusively by juveniles. He was, however, nearly fifty years old, when in 1801 he caused a sensation at the Paris Industrial Exhibition by demonstrating an improved draw-loom. The invention of a machine for the manufacture of fishing-nets procured for him a post at the Conservatory of Arts and Crafts, Paris. Here he was commissioned to overhaul Vaucanson's loom of 1745, about the running of which all instructions were lacking. Jacquard not only succeeded in getting the ponderous machine into working order, he studied and improved on Vaucanson's ideas to such good purpose that in 1805 he was able to appear before the public with the invention which made him famous.

The term Jacquard loom, which is frequently heard, is misleading. It is not a loom, but a comparatively small apparatus which may be mounted on any hand-loom, and is an automatic selective shedding-machine for figured fabrics, worked by means of a treadle. After the pattern of the draw-loom every warp-thread (ill. p. 563 left, Wa) runs through the loop of a cord (LC) which is carried upwards and is movable; they are held taut by weights

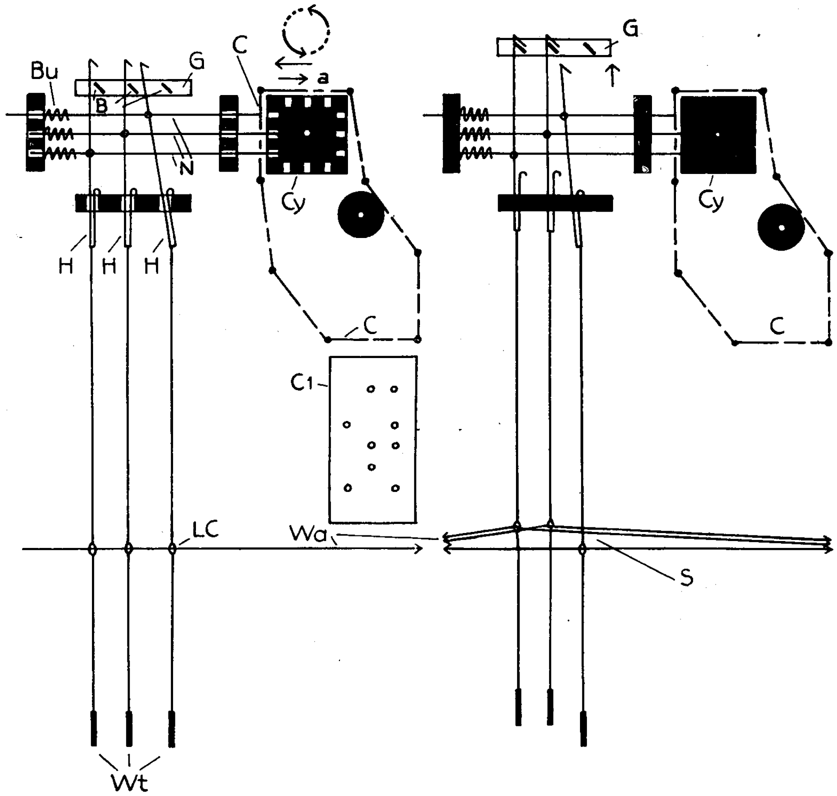
Vaucanson's improved loom, 1750.



Jacques de Vaucanson (1709–1782), famous mechanic and inventor of an automatic loom. From Chapuis "Le Monde des Automates". Paris 1928.

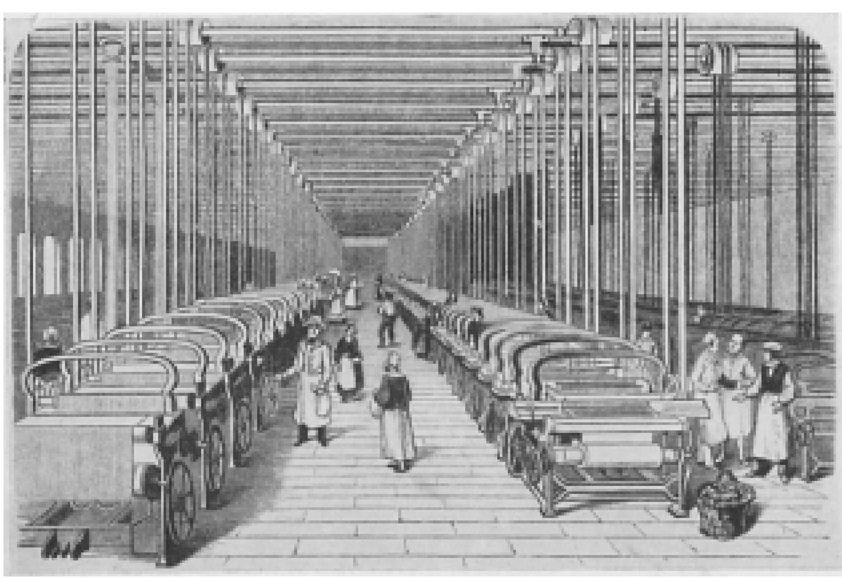
(Wt) attached to the lower end. Each cord is suspended from a wire which is known as a lifter or hook (H) which, as the name indicates, is bent at the top, to enable it to hook round, the blades (B) of the griff (G). If no further provision were made, all the hooks would move every time the griff was raised. To prevent the raising of certain warp-threads, the corresponding hooks must be thrust off the rising blades. This is done by means of the needles (N) which are connected with each hook. The spiral springs of the needles are contracted by means of a buffer (Bu). The automatic thrusting back of certain needles is achieved by means of the cylinder (Cy) a quadrangular block of wood, upon which perforated cards (C) are placed, an example of which is shown in (C_1). Only where the cards are perforated does the position of the needles remain unchanged. As shown in the second diagram on p. 563, only those hooks rise with the griff which have not been thrust into an oblique position. By this device a selective shed (S) is made, which corresponds to the details of the pattern, and the weft can be inserted and beaten down. To prepare the

Diagram showing Jacquard's automatic selecting machine. By G. Schaefer, Baslé.



shed for the next stage in the pattern the griff is lowered, and the cylinder moved in the direction indicated by (a), at the same time executing a quarter revolution. The cards are connected in the form of a chain, and each rotatory movement places a fresh card in position. The endless chain of cards allows of a repetition of the pattern as often desired.

Napoleon I, realizing the importance of Jacquard's invention, commanded the city of



Interior of a textile mill, about 1840.

Lyons to acquire the patents, and by payment of a pension to ensure itself of the further services of its inventive son. In spite of this protection Jacquard did not remain free from persecution. But his invention was universally recognized. By 1812 it had been fitted to 18 000 looms in Lyons. In 1834 the number was estimated at 30 000.

The Jacquard machine was constantly improved, and became a complete success. When fitted to the power-loom of Cartwright, it inaugurated the age of the entirely automatic loom. In the second half of the 19th century skilled engineers developed that wonder of ingenuity, the modern power-loom. In performance and quality of output these looms leave nothing to be desired, and in a single hall of a modern mill as much cloth is produced in 8 hours as was formerly made by 16 000 weavers in a long day of hard toil. The looms of Jacquard and Cartwright were far removed from such perfection. This later development of the modern power-loom will be the subject of a separate number.

Practical hints

The combined effect of light and perspiration on dyeings

During recent years exhaustive studies have been made to determine the fastness of dyeings and prints to the various influences. We know nowadays the behaviour under the influence of light, washing, perspiration etc. of dyeings and prints with the different groups of dyestuffs. We know also that the degree of alteration, which such prints and dyeings undergo, is dependant on the material, e.g. the fastness to light of dyeings on cotton is often quite different from that of the same color on viscose rayon. Similar differences can also be demonstrated by parallel washing tests.

A case worthy of special attention is that of a colour which shows a moderate light fastness under normal conditions but which exhibits a considerably reduced light fastness under varying conditions.

This question arose in connection with a cotton garment printed in a very pale shade with a vat color. The garment was only worn once on a hot cloudless summer day. Under the intense light exposure the pale print remained practically unchanged all over except for part at the back, which, in contrast to the remainder of the garment, appeared almost bleached. This part was in contact with the bare skin, consequently perspiration comes into consideration and undoubtedly the combination of light and perspiration was responsible for this phenomenon. An experiment with the same color, at the same depth of shade, and imitating the conditions as closely as possible gave the following interesting result:

A certain number of similarly dyed patterns were exposed to sunlight in the following manner:—

1. The dyed pattern dry, no further treatment.
2. The dyed pattern moistened with 1% acetic acid solution.
3. The dyed pattern moistened with 1% common salt solution.
4. The dyed pattern moistened with
   1% acetic acid solution +
   1% common salt solution } 1 : 1
5. The dyed pattern moistened with a solution of 10 cc. ammonia per litre.

The patterns were re-moistened a few times during the exposure and the results showed that in comparison with the other patterns, the one moistened with the mixture of acetic acid and common salt showed remarkable fading. The combined effect was thus also established in this case.

Although perspiration scarcely contains acetic acid, it does usually react acid, and always contains common salt, so it can be said with almost certainty, that in the aforementioned case, perspiration and light were jointly responsible for the fading. It is possible that under similar conditions in another instance, the above result might not be obtained since human perspiration has not always the same composition.

The usual fastness tests are almost always confined to the separate examination of the effect of light, washing, and perspiration etc., and are seldom extended to the joint effect of these influences. Similar results to the above may be obtained through the frequently recurring combination of washing and light exposure e.g. domestic washing. We cannot generalise from the above mentioned case but can say that the combined effect of light and washing, can in many instances give different results from those obtained in tests carried out separately. In view of the above observations it is always advisable to bear in mind the various possibilities in connection with fastness tests.

R. H.

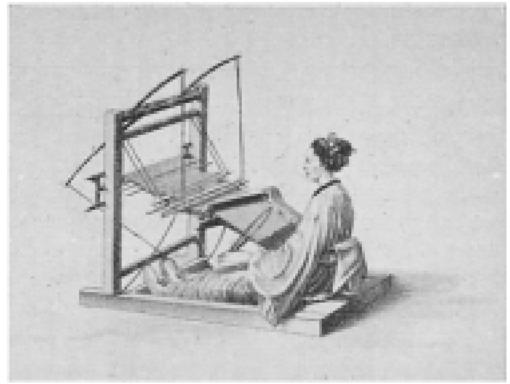
Looms of Asia

By G. Schaefer

The peoples of Asia regard the loom in a very different light from those of Europe. The fact that nearly all textiles, both plain ones for daily use and artistic figured fabrics, are woven on hand-looms, and that power-looms are to this day comparatively rare, is partly explained by the high standard of craftsmanship in the East, and partly by the respect and even veneration with which the loom is regarded in the chief silk and cotton producing countries of Asia. Thus in India the sacred book of Manu mentions weaving as a domestic craft, and lays down definite regulations for its practice. The Shinto monastery Isafu-no-Miya in Japan numbers among its nine sacred treasures the model of a loom in gilded

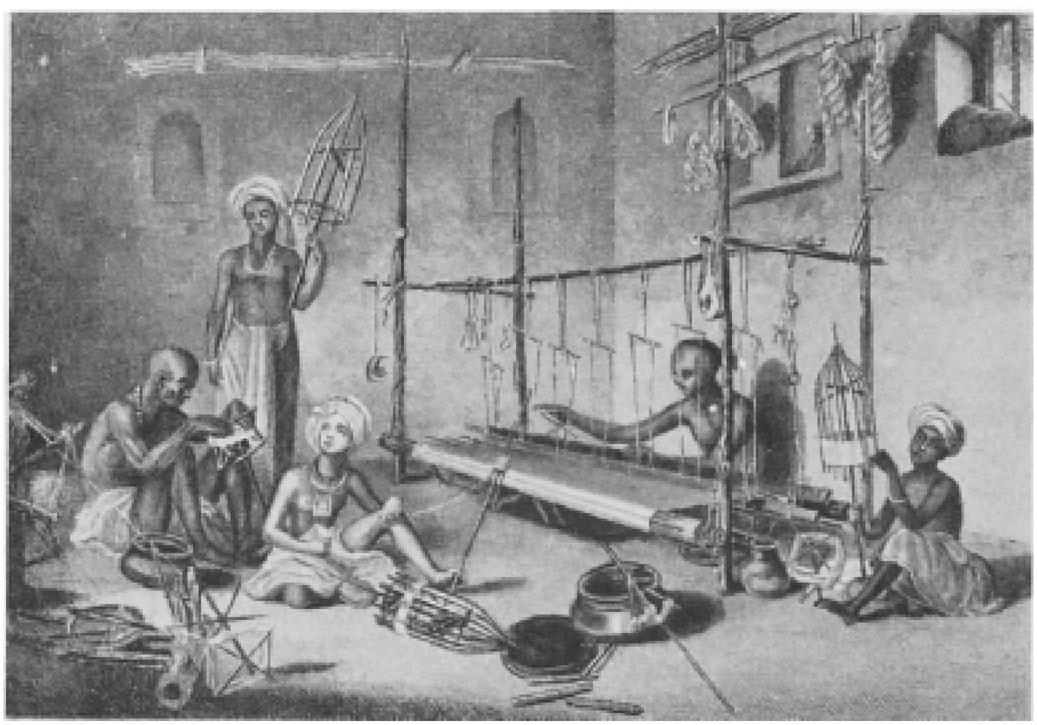
Indian hand-loom. Indian painting, ab. 1750. Ethnological Museum, Berlin. Photo: Historia-Photo.

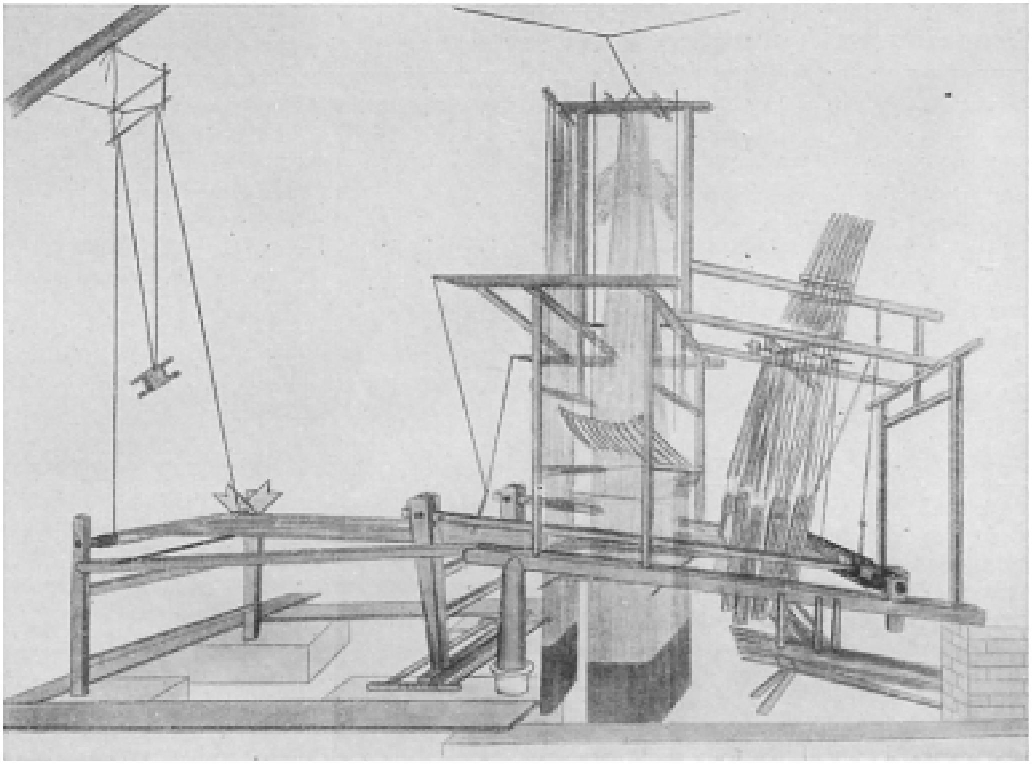
bronze, similar in type to those used in Japan a thousand years ago. On the looms of that period a weft of as many as five different colours was possible, whereas the same development of European weaving did not take place until after Robert Kay's invention in the 18th century. In accordance with the varying stages and strata of civilization in Asia we find primitive and advanced weaving-devices comparatively close together. Looms without a warp-beam, where the warp threads terminate in a rope of thread fastened to a stake in the ground are found both in India and Japan. In a type of small loom common in Japan the warp is stretched by the weight of the weaver's body, as he leans back with the threads attached to a belt round his waist. And yet the same loom has the comparatively advanced form of shedding-harness worked by treadles. Treadle-looms are very common in the Orient and in Asia. They are found on the Mediterranean coast, in Arabia, Asia Minor, Persia, India, Cochin China, and especially in the ancient homes of weaving, China and Japan. It is a peculiarity of the Indian treadle-looms that they are built over a pit dug into the ground, in which the treadle-mechanism, which is usually invisible in pictures, is situated. The so-called Cashmere looms, on which the famous Cashmere shawls are made, are operated by three weavers simultaneously, who require about three months for each shawl. The most highly-developed weaving instrument in Asia is the draw-loom, found particularly in the densely populated Hwang-ho valley in China, and on



Japanese loom. The warp is held in a primitive manner by a belt which the weaver wears, keeping the threads stretched by the weight of her body. Note the relatively advanced shedding harness.

Simple Indian loom. From "The Art of Weaving". London 1857.





Large Chinese draw-loom for the manufacture of silk fabrics. As well as a system of cords for selecting the warp as required, the loom has a multiple shedding harness. 19th century. From "China Silk". Shanghai 1881.

the Japanese islands. The European draw-loom was probably derived from that of Eastern Asia. The draw-loom is usually equipped with treadle-harness as well, which in silk weaving serves for the production of a plain base to strengthen especially delicate figured fabrics. The strings for selecting the particular shed required by the pattern are drawn by an assistant seated high up in the frame. In the Far East silk thread is chiefly used, the material considered the most suitable of all for weaving.

Weaving as Depicted in Japanese Art

By W. Born

Silk-growing and silk-weaving are among the earliest and greatest of China's contributions to civilization. Scenes from silk-weaving are, however, not among the subjects frequently chosen by Chinese artists. Art in Ancient China was essentially symbolic, and therefore limited in its range. Realistic art which was not above choosing a subject from the field of industry was to be found only in Japan, and even there not before the 18th century. At that time the art of Uki-yo-ye, of realistic coloured wood-cuts, was developed, the masters of which portrayed with admirable adherence to detail and exquisite decorative taste the life of every day.

Among these coloured wood-cuts there were characteristic scenes from the domestic weaving-industry of the period. A wood-cut by Uta-gawa Kuni-yoshi (1797–1861) shows a Japanese woman before a wooden instrument with spools and threads, beside which

Japanese loom. Ink drawing after Hoku-sai. Austrian Museum for Art and Industry, Vienna.

is a frame for variegating the warp. The wooden instrument is a species of reel for the

Women at the loom. The two concluding plates of the series "Silk-worm Culture, handiwork of Women", by Kitagawa Utamaro (1753–1806). Tokyo, ab. 1800.

twining together of various strands of silk. The famous engraver Hoku-sai (1760–1849) created in his illustrations to the "Letters Concerning the Education of the Young" a number of extraordinarily vivid scenes from industrial life, among them weaving. One of these (see ill.) shows a simple-loom ready for use, of the kind used for the manufacture of rich, figured textiles. A woman is standing before the loom. When at work she sits on a low bench on the left, where she works the treadles of the shedding apparatus, inserts and beats up the weft. The warp-threads are controlled by the draw-boy, whose place was on the empty platform beside the vertical cords.

In Chinese and Japanese mythology the (female) weaver is of some importance as a goddess of the skies. In this role she appears both on coloured Japanese wood-cuts and on products of the applied arts. According to the Japanese legend it was the task of Shoku-jo, the beautiful daughter of the sun-god, to weave the clothes for the paternal household. One day she met the herdsman Ken-gyû with his bull. Ken-gyû lived on the other bank of the celestial river. They fell in love, and were married. But they were so happy that they neglected their work, whereupon the gods demanded of Shoku-jo's father that he should separate the couple, who would then remember their duties. That was done, and now they see each other only once a year, on the seventh day of the seventh month. On that day the birds form a bridge across the celestial river, to enable the princess to visit her husband. On earth this reunion is celebrated as the feast of "Tanabata". The two lovers often figure on Japanese sword-guards, one of which is reproduced here, showing Shoku-jo at her loom, shuttle in hand. The wisps of cloud which partly obscure the loom symbolize the celestial scene. The sword-guard is chased, and inlaid with coloured metal. It bears the signature of Hamano Noryjuki, a famous swordsmith of the second half of the 18th century.

The celestial princess Shoku-jo working at her loom. Japanese sword-guard, 2nd half of 18th century.

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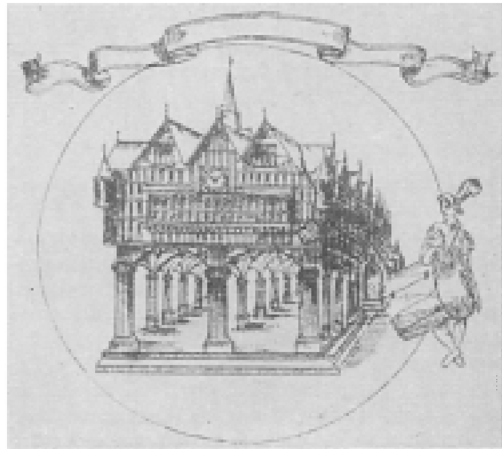
Historical Gleanings

Praise of Weaving in the Ancient Town Hall of Hereford

The old Town Hall of Hereford which was built entirely of wood in 1618–20 contained rooms reserved for the various guilds, the doors of which were richly adorned with pictures and inscriptions. In his "History from Marble" Thomas Dingley (died 1695) expressly mentions the inscription over the door leading to the cloth-workers' guildroom. Cloth-making is praised as the trade which outshines all others as the sun outshines the stars. The cloth-trade could enrich all classes, and enable them to live in plenty. Finally, the cloth-trade is compared with the bold voyage of the Argonauts who brought the Golden Fleece to Greece.

H. G.-N.

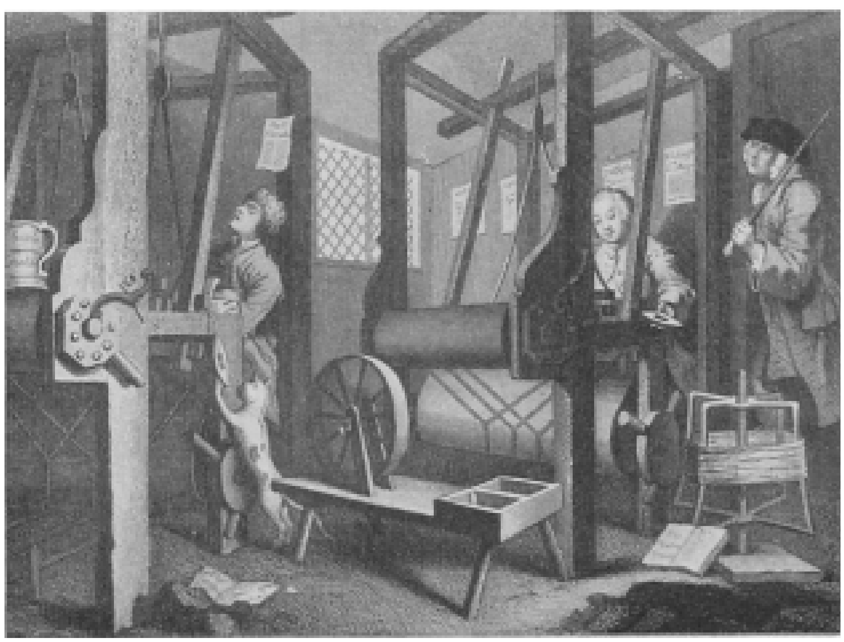


The Ancient Town Hall of Hereford. After a drawing from Thomas Dingley's (died 1695) "History from Marble".

William Hogarth and the Weavers

In a series of twelve engravings entitled: "Industry and Idleness" William Hogarth (1697–1764) describes the lives of the two cloth-weavers Goodchild and Thomas Idle. The first plate, "The Fellow Prentices at their Looms", indicates the character of the two with inimitable precision. Both are seated before their hand-looms; the industrious one is hard at work, and in the act of making a pick, whilst his fellow sits fast asleep before his loom, which is prevented from working by a beer-mug and a tobacco-pipe wedged between the levers. A cat is playing with the shuttle, having already chewed the manual, The Prentice's Guide, which is seen lying on the floor. The name Spittlefields on the mug indicates that the two lads are apprenticed to a weaver of that district, at that time the centre of the London textile-trade. The master is seen entering the room with a cudgel raised to strike, obviously intending to give the lazy one his just reward.

The fourth plate shows Master West in close conversation with Goodchild, who has meanwhile risen to the dignity of clerk. The two closely clasped gloves indicate the imminent betrothal of Goodchild and the master's only daughter. In the background, the workshop with looms and spinning-wheels, is visible; in front, a messenger, who appears surprised by the intimacy of the weavers and his clerk, is delivering



The industrious and the idle apprentices at their looms. Engraving by E. Smith after William Hogarth (1697–1764).

some bales of goods. In the two final plates of the series the destinies of the two—which were indicated by the names placed above them in the first plate, "Whittington" and "Moll Flanders"—have been fulfilled. Like Whittington, Goodchild became Lord Mayor of London, whilst Thomas Idle shared the fate of the heroine of Defoe's famous novel, and paid for his dissolute life on the gallows. W. N.

Two Types of Turkish Looms

were described by the Austrian scholar Otto Benndorf in 1884 in his book "Reisen in Lykien und Karien" (Travels in Lycia and Caria). The first type, known as a Juruk loom, after a Turcoman tribe, is, as the illustration shows, more like a complicated embroidery-frame than a loom. The technique closely resembles that of plaiting or braiding; the woman seen sitting at the loom draws the thread through the warp without the help of any instrument. Each thread of the weft is beaten in separately with a comb of wood or iron. The construction of the Juruk loom is not unlike that of the High-warp loom for tapestry-weaving and indeed the term "Metier de haute lisse" is merely a literal translation of the Saracen "Kaimet-el-kadar", meaning a high-warped loom.

Only plain or striped woollen cloth can be woven on the Juruk loom. For the manufacture of linen, the Turks use a different type of loom with an almost horizontal warp, the weft threads being introduced by a treadle apparatus. The weaver begins at the cloth-beam, and works towards the warp-beam, the finished portions of the cloth being wrapped round the cloth-beam, whilst the warp gradually moves towards the workman. W. N.

Turkish woman at the loom. Reprinted from "Reisen in Lykien und Karien". By Otto Benndorf and George Niemann. Vienna 1884.

Edmund Cartwright, an Inventor to the Last

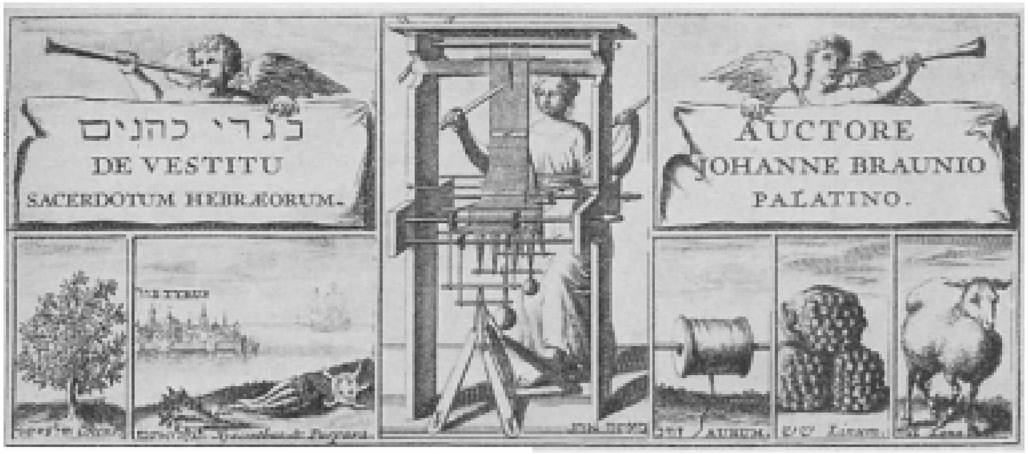
On April 24th, 1819, Cartwright wrote to his brother: "I, this day, entered into my 77th year in as good health and spirits, thank God, as I have done on any one birthday for the last half century. I am moving about my farm from eight o'clock in the morning till four on the afternoon without suffering the least fatigue. I sent in my claim to the Board of Agriculture for their premium for a cure of the mildew on wheat, but have not yet heard that it was admitted. I don't know whether I ever mentioned to you a machine for dibbling or planting wheat, which I have brought to great perfection. I have also a very material improvement on the stocks respecting ploughs and wheel-carriages: but of this I shall say nothing till I have brought it to the proof, which I hope to do very shortly."

Nothing could illustrate the humble spirit which thought only of the common good better than the following poem which Cartwright wrote shortly before his death:

Since even Newton owns that all he wrought
Was due to industry and patient thought,
What shall restrain the impulse which I feel
To forward, as I may, the public weal?
By his example fired, to break away,
In search of truth, through darkness into day?
He tried, on venturous wing, the loftiest flight,
An eagle soaring to the fount of light!
I cling to earth, to earth-born arts confined,
A worm of science of the humblest kind.
Our powers, though wide apart as earth and heaven,
For different purposes alike were given:
Though mine the arena of inglorious fame,
Where pride and folly would the strife disdain,
With mind unwearied still will I engage
In spite of failing vigour and of age,
Nor quit the combat till I quit the stage,
Or, if in idleness my life shall close,
Let well-earned victory justify repose. W. N.

Attempts to Reconstruct the Loom of the Ancient Hebrews

were made by the Dutch theologian Johannes Braun (1628–1708). They were based on all the information available in the Old Testament. In his book "De Vestitu Sacerdotum Hebraeorum" (The Dress of the Hebrew Priests), first printed 1680, he published everything contained in the Bible concerning textiles and their manufacture, together with a very illuminating commentary. The fifteen drawings of the title-page give an illustration of the results of several hundred pages of philological study. It was Braun's principal object to describe as accurately as possible the vestments of the Hebrew priests, and the nine illustrations of the lower and much larger section of the page are devoted to this purpose. The upper half, which is reproduced here, shows the loom as reconstructed by Braun, and beside it the raw materials: gold thread, flax, and wool, as well as the dyes, scarlet, red, and violet purple. Tyre is expressly mentioned as



Top half of title-page of Johannes Braun "De Vestitu Sacerdotum Hebraeorum", 2nd edition. Amsterdam 1698.

the place of origin of the latter two dyes. The drawing of the loom shows that Braun was unable to get away from the conceptions of his own age, for he drew a loom differing scarcely at all from the type common in the century preceding his own, though he erroneously equipped his sketch of a high-warp loom with the shedding harness of the horizontal loom. W. N.

Warp and Weft in Eastern Symbolism

The fundamental element of weaving, the linking of warp and weft, has acquired symbolic meaning in India and China. Thus the Chinese words for warp and weft, are "king" and "wei"; king also stands for a classic of literature, and wei is the name of the commentaries to it.

In a more general sense, the elements of weaving have assumed a profound symbolic meaning. The warp, firmly attached to the frame of the loom, symbolizes the immutable forces of the world, whilst the weft, which moves lightly to and fro between the warp-threads, stands for the transient affairs of man. Other symbolic meanings are derived from the cross formed by the linking of warp and weft. In Indian symbolism the horizontal threads of the weft stand for the stages of the individual life, whilst his super-individual, eternal existence is represented by the vertical threads of the warp. Finally, the warp threads of the fabric symbolize the male principle (purusha), and the weft indicates the female principle (prakriti). In the Upanishads the superior Brahma is described as that on which the worlds are woven, like weft on warp. The threads which form the "world fabric" are sometimes called the "hairs of Shiva". H. G.-N.

A Medieval Draper's Shop

The French cloth-merchants' and cloth-makers' guild was founded in 1188 under the name Confreria Draperiorum by a charter of Louis VII. In a document of 1270 the prices for various kinds and sizes of cloth are fixed. Sales took place either in the market-halls or in individual shops, only members of the guild were allowed to sell, the numbers of their stalls being allotted twice yearly by the drawing of lots. Private trading was banned. The man in the illustration, who is seen serving a customer, is therefore a member of the guild, maker and merchant in one. Two assistants, a man and a woman are at work, apparently hemming pieces of cloth. A.V.

Ribbon-Weaving and Sense of Touch

In the Museum of Arts, Berlin, there is a richly carved ribbon-weaving frame, probably made at

Medieval draper's shop. From "Tacuinum Sanitatis", 14th century. (Bibl. Nat., Paris, MSS. lat. 1673.)

Ribbon-weaving symbolizing the sense of touch. Engraving by Georg Pentz (about 1500–1550).

Nuremberg between 1568 and 1535. It is one of the most charming examples of applied art of that period, and enables us to reconstruct the process of weaving, which was very similar to the board-weaving practised in Ancient Egypt (cf. Ciba Review No. 12). With the help of an engraving by Georg Pentz of the same period Julius Lessing in 1906 succeeded in giving a complete description of medieval ribbon-weaving, which was not only an independent trade, but also a domestic occupation. The warp-threads were stretched between two rollers mounted on stands. One of the two rosettes in which each roller ended, and which are adorned with gargoyles in the picture, was saw-edged, and fitted with a ratchet, so that the warp could be tautened as desired. The weaver inserted the weft-threads into the warp with his right hand, forming the shed with his left. If the fabric was coloured, several shuttles were necessary (in Pentz's engraving the threads from which the shuttles are hanging may be seen quite plainly). The loom illustrated permits of the manufacture of ribbons more than a handbreadth wide, though 1 or 1½ ins. was more usual; such ribbons are shown on the table in the illustration. Intricate patterns required considerable delicacy of touch, if the warp-threads were to be raised in the correct order. It was for that reason that Pentz chose this theme to symbolize the sense of touch (tactus) in his illustration of the five senses. W. N.

John Kay's Struggle with the Weavers of Rossendale and Rochdale

Shortly after exhibiting his invention of the fly-shuttle (patented 1733) in Lancashire, Kay realised that the weavers of that district were using his wheel-shuttle as it was then called, without paying the fees due to him as the holder of patent rights. When he invoked the protection of the law-courts in 1737 and 1740 against the weavers of Rochdale and Rossendale, the defendants declared that the shuttle used by them was similar in type to the one designed by Kay, but was of earlier date; they also maintained that Kay's invention was not of practical use. Nevertheless, they probably did use his invention, though they did not accept the fly-shuttle until the 19th century. The apparatus used by them, which they called the bocking machine and which made it necessary for a man on either side of the loom to direct the weft, was, according to G. H. Tupling, probably identical with the rigid spool, which was the subject of Kay's law-suit against the weavers of Rossendale in 1737.

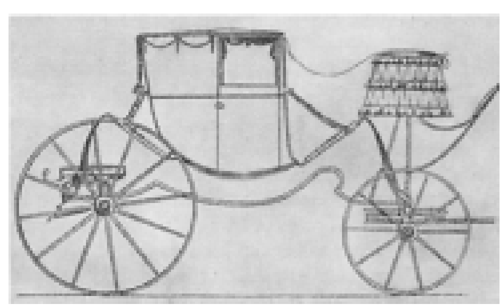
In T. Newbigging's "History of the Forest of Rossendale" (1868), a certain John Maden, not otherwise known as an inventor, is mentioned as having lived from 1724 to 1809 at Bacup, and to having constructed a shuttle, in which a system of wheels made it possible for one man to work the loom. Kay's law-suit of 1740 had, however, proved that the weavers of Rochdale and Rossendale were familiar with such a wheel-shuttle; it is therefore likely that John Maden did no more than improve on an already existing mechanism. H. G.-N.

Travelling Coach of 1791

Bertuch's "Journal des Luxus und der Moden", at the end of the 18th century Germany's leading Society journal, had its correspondents in every capital, whose letters reported on all fashionable events, inventions, novelties, and whims.

In the March number of 1791 the London correspondent embellished his report on fashionable carriages with a sketch, described as exceedingly "Charmante" (see ill.) which reproduces in delicately traced lines the curves and contours of the most popular vehicle of

An English "désobligeant" (carriage, for use in town and country). From Bertuch's "Journal des Luxus und der Moden". Weimar. March, 1791.



the period. To quote the letter dated 8th March, 1791: "...The most useful and most popular carriages are the so-called désobligeants as illustrated, which are suitable both for use in town and for travelling. For the latter purpose it is only necessary to add a footman's seat in the rear, in the front—under the box—a trunk with a leather cover, and to screw two lamps to the sides. With the exception of the wheels the frame is entirely of iron, namely: two iron crane-necks, four springs, iron axles and screws, and an iron box-seat, which gives to the vehicle the appearance of great lightness. The body is nearly always painted in bright colours, olivegreen, light grey, orange, light yellow, blue, etc., without any further ornament. Nearly all English people in the habit of travelling in France, Germany, or Italy, keep such carriages in their own coach-houses at Calais." G. De Fr.

Gloves from Spiders' Webs

were sent by Saint-Hilaire, the president of the court of Aix, to the consort of the German Emperor Charles VI. On Dec. 5th 1709 a report was presented to the Royal Society of Montpellier, according to which the thread produced by spiders might be spun into a species of silk stronger and more durable than that of the silk-worm. In 1710, Réaumur wrote a "Mémoire sur la soie de l'araignée", in which he gives details of gloves and stockings made of spiders' webs. In some provinces of China the webs of a moth called the spinner were collected and sold to Europe. In 1892 M. B. Rolt was awarded a gold medal in London for his experiments with spiders' webs. By means of a spool rotating at a speed of 154 revolutions per minute he was able to produce in the space of from three to five minutes a white, metallic thread of 200 to 300 yards in length. A.V.

The Stars and Stripes in the Flag of the United States of America

have given rise to a great deal of conjecture as to their origin. They have often been connected with the crest of the Washington family, which also was made up of stars and stripes, though in different colours and arrangement. As George Washington is known to have taken part in the designing of the flag in July 1776, it is quite possible that he was influenced by the memory of his own coat-of-arms. The general design of the flag of the rebel colonies which was hoisted at Boston for the first time on Jan. 2nd 1776, was of entirely different origin, being identical with that of the East India Company, and bearing six white stripes on a red ground, with the Union Jack in the top left corner. The colonists regarded the East India Company as their worst enemy; the monopoly of importing tea into America, which the Company held, was the immediate cause of the conflict between mother-country and colonies. With the plundering of the Company's ships and the Boston Tea Party the American War of Independance had begun. As a sign of triumph and of scorn for their hated opponent the rebels hoisted the latter's own flag on Jan. 2nd 1776. When Washington

Washington's book plate. After the original in Frank's Collection of book plates. British Museum, London.

designed the flag of the United States of America six months later he merely replaced the Union Jack by the stars. W. N.

John Kay's End

In spite of the general recognition which was accorded to the fly-shuttle (see p. 558 seq.) Kay's fate was not a happy one. The Yorkshire manufacturers who made use of his invention were not willing to pay him the fees which were his due as the inventor; they even formed an association called the Shuttle Club to raise the expenses of the law-suit in which they endeavoured to resist his claims. Though Kay finally won his case, the costs of litigation had absolutely ruined him. An anonymous pamphlet published in London in 1780 and entitled "Letters on the Utility and Policy of employing Machines to Shorten Labour" contains an extract from a letter written by Kay to the Society of Arts in 1764, which says: "I have a great many more inventions than what I have given in, and the reason I have not put them forward is the bad treatment I have had from woollen and cotton factories in different parts of England twenty years ago, and then I applied to Parliament, and they would not assist me in my affairs, which obliged me to go abroad to get money to pay my debts and support my family." The letter was probably written from France, where Kay died in great poverty about the year 1774. W. N.

Scientific Notes

A Veterinary Cookery Book

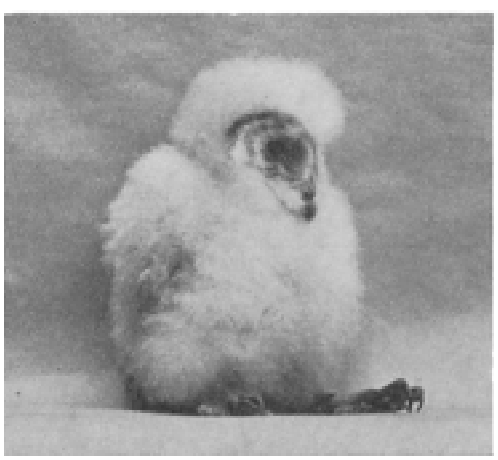
was published recently by the Leipzig zoologist Krumbiegel. It contains valuable information concerning the proper feeding of every group of animal from amoebae to gorillas. The menu for Japanese crickets (distramena marmoratum) is given as: Small pieces of tangerines and other fruits, and slightly sweetened flour-paste. For this purpose it is necessary to have sufficient fresh water in order to enable the animals to clean their mouths. Further items are excrements of mice and crushed flies, which prevent the animals from becoming cannibals, boiled carrots, rice, and potatoes. To feed fleas it is necessary to place them next the skin in small cages or boxes. The okapi, one of the rarest inmates of zoological gardens, is fed on milk, beans, lentils, ferns, bananas, etc. H.

The Down Coat of the Owl

The downy plumage of the owl as compared with that of other birds shows some complication in the succession of the various generations of feathers. Whereas many young birds; known by the general term autophagi (e.g. gulls, domestic fowl, etc.) are covered with a nest plumage which is formed in the embryo stage, owls, which are much more helpless when hatched, have two successive coats of down, which precede the development of the feathers proper, the plumage of the grown bird. Young owls when hatched are covered with down of a usually light colour, which gives them the appearance of a ball of wool (see ill.). Beneath this first down a second generation of soft feathers grows from the same quill. Only when the final plumage appears are these two successions of down shed in whole tufts and bunches.

The second down feathers are particularly soft in the case of the barn-owl. The two successions of down are in reality part of the same feather. The separation into several tufts of down is probably due to an interruption of growth. The young horned owl (see ill.) shows the tufts of ear-feathers (the horns) which are so conspicuous in the mature bird; as yet the tuft is of down, which may still be discerned on the feathers when the bird is fully fledged.

Barn-owl in first down plumage. Photo: A. Gerber, Basle.



Young horned owl in attitude of defence. 2nd down plumage, under which, especially on the wings, the final feathers are emerging. Photo: Ritter, Basle.

Young horned owl. The "horns", as yet of down, may be discerned quite plainly. Photo: Ritter, Basle.

Foxes attack Deer

It is well-known that foxes occasionally attack game larger than their usual prey of poultry, rabbits, moorhens, etc.

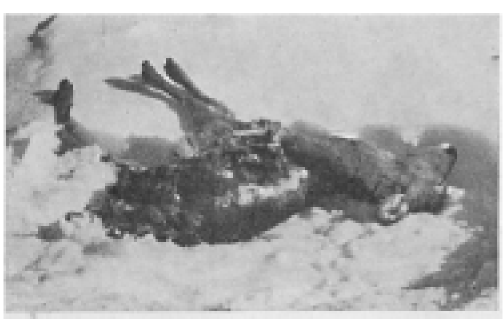
The following should be of interest both to the animal lover and the preserver of game.

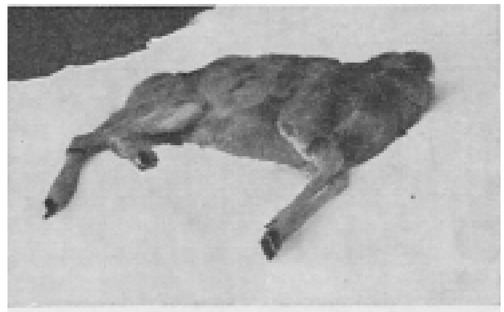
Until about thirty years ago the roe did not occur in the woods of the Upper Engadine, Switzerland, about 5000–5550 ft. above sea level. Only very gradually has it found its way there from the lower slopes. (Some experts claim that it would not be wise to allow deer to make their home in these districts, as the forests have not sufficient undergrowth to afford adequate protection to the animal.) As the rabbits in the woods of the Upper Engadine have been almost wiped out by foxes, attacks on deer have occurred frequently in severe winters, though never to the extent reported these last two years, which brought unusually heavy falls of snow. The narrow hooves and the thin legs of the roe sink deeply into the snow, and are frequently injured by the surface layer of frozen snow.

Sweat aids the fox in picking up the scent, he hunts the roe and attacks its legs and breast, which he tears open. Early in 1936 fifteen roes, all young animals, were found in the Upper Engadine valley in the course of eight weeks; all had been killed by foxes. In each case the tracks of the fox were found, and there seems no doubt that Reynard was the culprit, though dogs have been known to attack deer. Carcases were repeatedly found showing no wounds about the breast, but with the head torn off. This would seem to suggest that under given circumstances foxes specialize in this form of kill, especially where young animals are concerned. The head is taken to the fox's den and there devoured, sometimes only the brains. The occurrence of "head-hunters" among foxes has been confirmed by sportsmen of other mountain valleys, though they are described as very rare.

F. Breiter, St. Moritz.

Roe, killed and partly eaten by a fox. Photo: B. Schocher and gamekeeper Rauch, Pontresina.





The fox has bitten off the head of the roe, without otherwise materially injuring the carcase. Photo: Pedrett, St. Moritz.

Male Birds which Brood

are by no means rare. As a rule such birds share the duties of hatching with the females, as in appearance resemble the latter, that is to say, birds whose plumage is not too striking. The times of sitting are usually carefully regulated. In the case of the black swan, for instance, the male sits from 10 a.m. to 5 p.m. daily, the female for the remainder of the time. A similar rule, according to which the male sits during the day and the female at night, is observed by the common sparrow and the stork. Hens, ducks, ostriches, and others do not follow this rule.

Hatching and caring for the young is usually performed by one bird, generally the female, though there are cases where the father performs all these domestic duties. The female of the phalarope species lays several clutches of eggs, each of which is hatched by a different male, whilst the female remains in the vicinity to ward off enemies. Some plovers abandon their eggs altogether, leaving everything concerning their progeny to the male. The female does not even remain in the vicinity, but moves South. The female emu, a native of Australia, lays from 6 to 9 eggs, each weighing about $1^1/_4$lb., and requiring 56 days sitting. Only during the first three weeks does she occasionally relieve the cock for some hours during the night, after that he is left to himself. Later he has to tend the young, and even defend them against their own mother. The strangest example of the male bird's care for the eggs is the talegalla fowl. The bird spends years scraping mould and leaves together to form a heap in some moist and secluded spot in the woods. When he considers the heap large enough, he entices a hen to the spot. When the eggs, which are particularly large, are laid, the male carefully instals them in the incubator he has provided. There his solicitude ends; in about six weeks the young birds work their way independently through the egg-shells and leaves, and require no further assistance whatever.

K.

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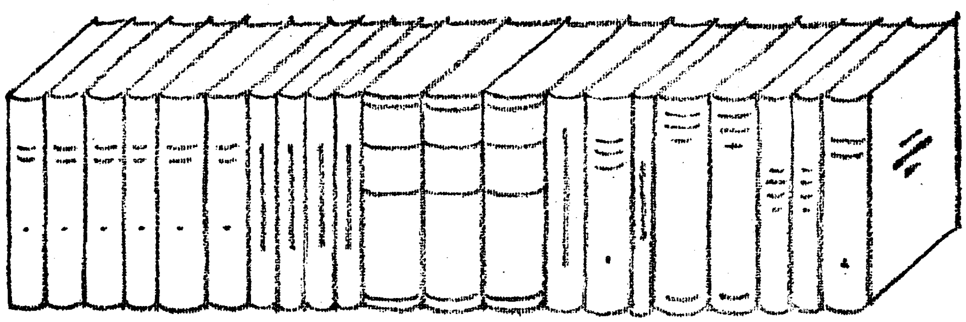

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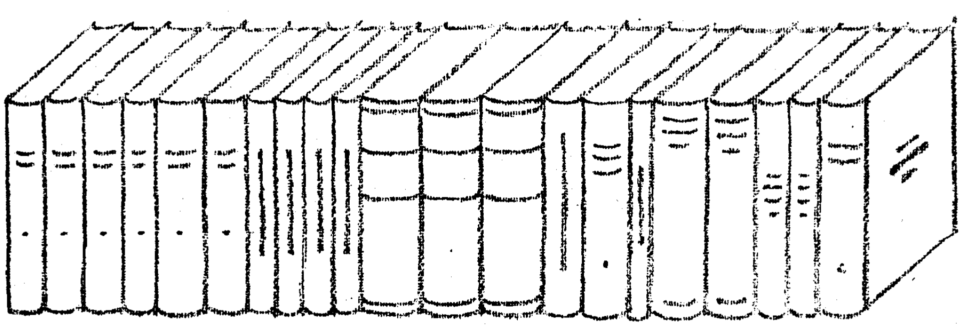

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